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Sport Fishery Abstracts

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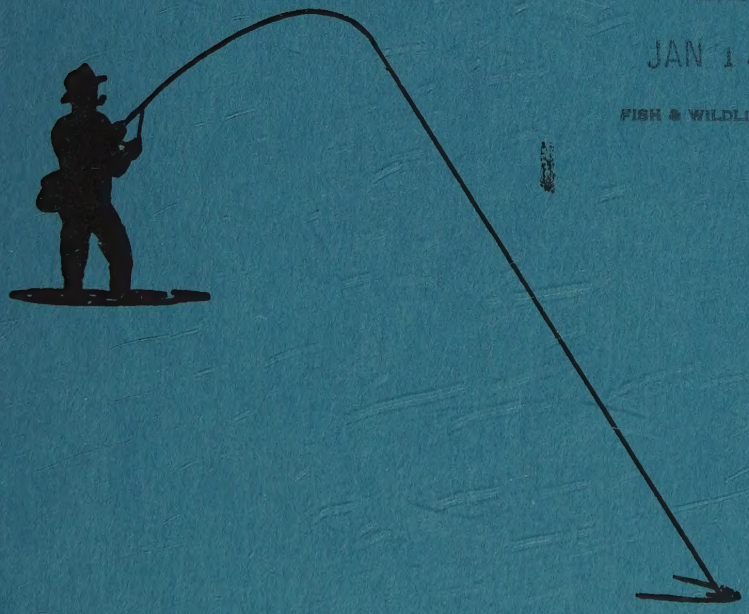

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Sport Fishery Abstracts

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes. The last number of each volume contains a list of publications screened for appropriate material.

Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

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6652. Walters, Vladimir, and Harry L. Fierstine (Dept. of Zool., Univ. of California, Los Angeles). 1964. MEASUREMENTS OF SWIMMING SPEEDS OF YELLOWFIN TUNA AND WAHOO. Nature, Vol. 202, No. 4928, pp. 208-209.

Swimming speeds of yellowfin tuna and wahoo were measured with the use of a spinning rod and a spinning reel containing fishing line marked with iron powder. A magnetic pick-up was mounted near the tip of the rod so that when a hooked fish pulled line from the reel, the magnetic field was disturbed by the iron powder markings. The resulting electric signal was fed into a tape recorder. Maximum burst velocity in km/h for five yellowfin tuna was as follows: 35.87, 24.86, 18.83, 74.59, and 45.25. For three wahoo the burst velocity measured 43.71, 43.34, and 77.05 km/h. It is believed that these species can probably attain higher velocities than are reported in this study.

6653. Martin, W. R., and Yves Jean (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, N. B., Canada). 1964. WINTER COD TAGGINGS OFF CAPE BRETON AND ON OFFSHORE NOVA SCOTIA BANKS, 1959-62. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 2, pp. 215-238.

During the winters of 1959 to 1962, 2459 commercial-sized cod were tagged off the Canadian coast south of the Laurentian Channel. Most returns came from the same general area. Very few cod crossed the Laurentian Channel to Newfoundland or Gulf of St. Lawrence North Shore grounds, or the Scotian Gulf to grounds off western Nova Scotia. Several cod populations were observed, each moving south in autumn and north in spring months. Fish tagged off central Nova Scotia did not migrate as far as the Gulf of St. Lawrence, but those tagged off Cape Breton migrated into the southwestern gulf for summer months. Fish marked in the middle of the area were intermediate in their migration pattern.

Temperature and feeding appear to be the important factors associated with cod migrations. Cod remain in temperatures of 1° to 4° C during winter months by moving to deeper water. In spring, cod disperse and feed in shoaler water. The cod of the Western-Emerald Banks area move east over the Scotian Shelf. The Gulf cod move up through the cold-water layer and north to inshore feeding near the Magdalen Islands and the Gaspé Peninsula. (Authors)

6654. Thomas, M. L. H. (Fish. Res. Bd. of Canada, Biol. Sta., London, Ontario, Canada), and H. R. McCrimmon. 1964. VARIABILITY IN PAPER ELECTROPHORETIC PATTERNS OF THE SERUM OF LANDLOCKED SEA LAMPREY, PETROMYZON MARINUS LINNAEUS. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 2, pp. 239-246.

One hundred and fifty-eight samples of sea lamprey (Petromyzon marinus L.) blood were analyzed using paper electrophoresis at pH 8.6. The specimens were of two phases in lamprey life history, the parasitic phase and pre-spawning phase. Variations in serum protein concentration, positions, and sizes of the fractions were associated with the state of life history, sex, and disease. Most of the variation between phases of life history was in the dominant fraction, an albumin. There was a decrease in total stainable protein while specimens were starved in captivity. Disease caused several changes in the pattern, the most striking of which was an increase in size of fraction 6, probably α-globulin. (Authors)

6655. Connor, Anne R., Carl H. Elling, Edgar C. Black, Gerald B. Collins, Joseph R. Fauley, and Edward Trevor-Smith (Dept. of Physiology, Univ. of British Columbia, Vancouver, B. C., Canada). 1963. CHANGES IN GLYCOGEN AND LACTATE LEVELS IN MIGRATING SALMONID FISHES ASCENDING EXPERIMENTAL "ENDLESS" FISHWAYS. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 2, pp. 255-290.

Certain aspects of the performance and biochemistry of adult migrating salmonid fishes were investigated during ascents of 1:16- and 1:8-slope experimental fishways which employed locking devices permitting the simulation of fishways of any length. Fish tested were chinook salmon (Oncorhynchus tshawytscha), sockeye salmon (O. nerka), and steelhead trout (Salmo gairdneri) diverted from their upstream migration on the Columbia River at the Booneville Dam fishways during the summer of 1959. Blood and muscle lactate, and muscle and liver glycogen levels were determined in control fish, and in fish following three types of activity. Records of individual performance were kept.

All species were willing to enter and capable of ascending fishways of either slope up to 1000 ft. in height under favorable hydraulic conditions. Blood lactate and muscle glycogen determinations revealed the degree of exercise to be moderate even during prolonged ascents. Moderately high ascents (about 100 ft.) in the steeper fishway apparently required the expenditure of some muscle glycogen, whereas similar ascents in the 1:16 fishway did not. When muscle glycogen was utilized during prolonged ascents the expenditure appeared to be progressive. All species were apparently able to adapt to prolonged ascents of either fishway. Certain fish of each species tended to stop moving of their own volition in both fishways. After a 60-min. volitional stop, some evidence of recovery from the effects of exercise were observed. Discussion of the above data is presented. (Authors)

6656. McNaught, Donald C., and Arthur D. Hasler (Lab. of Limnol., Dept. of Zool., Univ. of Wisconsin, Madison). 1963. RATE OF MOVEMENT OF POPULATIONS OF DAPHNIA IN RELATION TO CHANGES IN LIGHT INTENSITY. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 2, pp. 291-318.

A knowledge of the rate of vertical movement of a planktonic population is a prerequisite for the interpretation of the role that various factors play in depth control. A method for estimating this characteristic

of a planktonic population of Daphnia is described. Several estimates of the net rate of movement have been determined within each of the four periods that characterize the migratory behavior of Daphnia in Lake Mendota, Wisconsin; a series of rates were calculated for each of 11 cruises of approximately 24 hrs. duration. In most cases, a linear relationship exists between the rate of vertical movement and the rate of change in the logarithm of the light intensity; a number of such relationships are summarized for three of the four periods of movement. An increase in the slope of this relationship with increasing temperature is evidence that the rate of movement in Daphnia is proportional to temperature. The consistent pattern of the rates of movement during the dawn rise and the subsequent regularity in timing of the morning maximum in relation to sunrise together provide the most striking aspect of the diel migration in Mendota. From the onset of the dawn rise, the rate of upward movement increases to a maximum at or slightly preceding sunrise and, hence, decreased to zero at the time of the morning maximum. Typically, the maximal rates do not exceed 1.5 m/hr. The mean morning maximum at the surface occurs 60.2 min. following sunrise, with a standard deviation of 37.2 min.; the mean evening maximum at the surface occurs 19.4 min. before sunset, with a standard deviation of 61.0 min. Those morning maxima which deviate substantially from the mean were commonly formed under conditions of moderate to heavy cloud-cover. Behavioral evidence suggests a threshold of visual sensitivity of 10^{-4} to 10^{-5} lux for Daphnia. The mean amplitude of vertical movement characteristic of Daphnia in Mendota is 0.87 m, with a range from 0.29 m to 1.52 m. Comparative evidence supports the conclusion that the magnitude of the observed amplitudes of vertical movement are logical for an eutrophic lake such as Mendota. Aggregations of Daphnia at various levels present a problem in the design of a program to determine the periodicity of diel migration. Various types of aggregations are summarized within a framework of related environmental factors and with a description of the methods employed to meet the problem. (Authors)

6657. Townsley, P. M., and M. L. Hughes (Fish. Res. Bd. of Canada, Technol. Res. Lab., Halifax, Nova Scotia). 1963. EARLY STAGES IN THE RECOVERY TO INJURY IN THE DORSAL FIN OF THE ATLANTIC COD (GADUS MORHUA). Journal of the Fisheries Research Board of Canada, Vol. 21, No. 2, pp. 347-354.

The early stages in the recovery of the dorsal fin of the Atlantic cod (Gadus morhua) to a "clean-cut injury" are described. It is concluded that the observed rapid epidermal migration, wound closure, and cell mitosis are essentially the same in in-vivo as in in-vitro experiments. An accumulation of carbohydrate material occurs in the outermost layer of epidermal cells. There is a change in the carbohydrate composition or structure in the dermal layers at the site of injury. The basal epidermal cells rapidly divide in the in-vitro culture; whereas, only those basal epidermal cells in an in-vivo injury in close proximity to the injury divide. The surrounding nutrient medium in in-vitro cultures does not appear to be involved in the initial cell migration. However, ascorbic acid does stimulate epidermal migration, mucous secretion, and basal epidermal cell mitosis. (Authors)

6658. Watling, Harold, (Dept. of Zool. & Ent., Montana State Coll., Bozeman), and Howard H. Hillemann. 1963. THE DEVELOPMENT OF THE OLFACTORY APPARATUS OF THE GRAYLING (THYMALLUS ARCTICUS). Journal of the Fisheries Research Board of Canada, Vol. 21, No. 2, pp. 373-396.

The development and histology of the olfactory apparatus of the grayling (Thymallus arcticus) was studied from its anlage on day 8 through day 60 post-hatching, and also in its adult condition.

A correlation exists between length of fish and the number of olfactory lamellae.

A provisional interpretation is provided for the origin of the neurilemmal cells surrounding the unmyelinated olfactory fibers.

The rhythmic movement of water through the olfactory apparatus coincides with that of external respiration. (Authors)

6659. May, A. W. (Fish. Res. Bd. of Canada, Biol. Sta., St. John's, Newfoundland). 1963. AN ASYMMETRICAL PAIR OF COD OTOLITHS. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 2, pp. 413-414.

A cod (Gadus morhua L.) with dissimilar otoliths occurred in a sample taken on May 3, 1963, in a depth of 110-112 fathoms on the southeastern part of Hamilton Inlet Bank (53°36'N, 53°20'W). The fish was an immature male, 31 cm in length.

The left otolith presented a normal appearance for this size of fish. The right was markedly smaller and had a crystalline outgrowth on the posterodorsal edge.

The occurrence in any species of an asymmetrical pair of otoliths can probably be regarded as rare, and should not cast doubt on the otolith method of age determination. A routine practice of obtaining scale samples would provide a check should this phenomenon occur, or should otolith age interpretation be unreliable for other reasons.

6660. Jones, Robert S., William B. Ogletree, John H. Thompson, Jr., and Wm. Flenniken (Inst. of Marine Science, Univ. of Texas, Port Aransas). 1963. HELICOPTER-BORNE PURSE NET FOR POPULATION SAMPLING OF SHALLOW MARINE BAYS. Publications of the Institute of Marine Science, Vol. 9, pp. 1-6.

A new technique has been developed for sampling animal populations in marine bays. A helicopter-borne net is utilized to trap an area of about 1/40th of an acre (100.4 sq. m.). The net shape is maintained by a light-weight, circular, aluminum frame 50 feet in diameter. The net is released in the drop

zone by means of an electro-magnetic suspension system, and pursed by boat. Data taken in Corpus Christi Bay (Texas) showed an average biomass of fishes to be 107.7 lbs. per acre, ranging from 44.8 to 165.6 lbs. per acre (wet weight). (Authors)

6661. Hoese, H. D., and R. S. Jones (Inst. of Marine Sci. & Dept. of Zool., Univ. of Texas, Port Aransas). 1963. SEASONALITY OF LARGER ANIMALS IN A TEXAS TURTLE GRASS COMMUNITY. Publications of the Institute of Marine Science, Vol. 9, pp. 37-47.

A one-year study was made of macro-invertebrates and fishes in the grass flats of Redfish Bay, Texas, using a drop-net quadrat. The major invertebrate was Penaeus duorarum and the major fish Lagodon rhomboides. Population levels of nearly all species suddenly increased to high levels and decreased as rapidly to former low levels. Heaviest populations occurred in spring (4.9 gm/m^2 in May) with a secondary high in fall (3.5 gm/m^2 in mid-September and October). Lowest populations occurred in summer (0.8 gm/m^2 in mid-July to mid-August) and winter (0.46 gm/m^2 in January). Total population densities were correlated best with water level, but summer and winter minimums coincided with many adverse factors. The fauna was similar to that of Florida west coast bays where the major habitat type is the same. (Authors)

6662. McFarland, William N. (Inst. of Marine Sci., Univ. of Texas, Port Aransas). 1963. SEASONAL PLANKTON PRODUCTIVITY IN THE SURFZONE OF A SOUTH TEXAS BEACH. Publications of the Institute of Marine Science, Vol. 9, pp. 77-90.

Seasonal change in the oxygen metabolism of the microconstituents of surf water at Mustang Island, Texas, were measured using a light-dark bottle method. The gross photosynthesis, net photosynthesis and respiration of plankton reached highest levels during summer and fall and lowest levels during winter. Respiration during summer averaged 1.05 g O_2/m^3 per day and was four times the average winter respiration. Net photosynthesis during summer averaged 0.99 g O_2/m^3 per day and was nearly three times the average winter rate. A net photosynthesis occurred throughout the year except during spring, when periodic bursts of high spring respiration coincided with large numbers of decapod larvae in the surf water. Seasonal change in temperature, salinity and beach water currents are also related to the seasonal change in plankton productivity. (Auth.)

6663. McFarland, William N. (Inst. of Marine Sci., Univ. of Texas, Port Aransas). 1963. SEASONAL CHANGE IN THE NUMBER AND THE BIOMASS OF FISHES FROM THE SURF AT MUSTANG ISLAND, TEXAS. Publications of the Institute of Marine Science, Vol. 9, pp. 91-105.

During 1960 and 1961 the numbers and biomass of fishes in the surf at Mustang Island, Texas, were measured seasonally by seining procedures. A total of 47 species of fish were captured and are classed as all-year, spring-summer, summer, and winter-spring residents, or, as sporadic occurrences. During winter, on the average only four species were captured from the surf. Species captured increased to an average of 16 during summer. Biomass of fishes increased from a winter mean of 25.8 pounds to a summer mean of 103.2 pounds of fish per surface acre of surf. Mugil cephalus was the most common fish and constituted 46% of the total weight of fish captured.

The available data on seasonal abundance suggests that the most abundant species, or their ecologic counterparts, are represented heavily in the beach fish fauna from year-to-year. The most abundant species either are or tend to be predominantly plankton feeders. Estimation of the assimilation and importation of organic carbon to the beach, in the form of plankton, indicate that it is more than sufficient to sustain the fish population during summer. It is concluded that the beach fauna of the Texas coast is largely dependent on plankton for its existence. (Auth.)

6664. Copeland, B. J. (Inst. of Marine Sci., Univ. of Texas, Port Aransas), and W. R. Whitworth. 1963. OXYGEN METABOLISM OF FOUR OKLAHOMA FARM PONDS. Publications of the Institute of Marine Science, Vol. 9, pp. 156-161.

Oxygen metabolism of four Oklahoma farm ponds was studied during the spring and summer of 1962. Gross photosynthetic productivity ranged between 4.4 and 27.4 gm O_2/m^2 per day and total community respiration ranged between 6.4 and 26.4 gm O_2/m^2 per day. These values are of the same magnitude or higher than those reported for similar unpolluted communities and only slightly less than those reported for polluted systems. (Authors)

6665. Beyers, Robert J., James L. Larimer, Howard T. Odum, Richard B. Parker, and Neal E. Armstrong (Univ. of Texas, Inst. of Marine Sci., & Dept. of Zool., Port Aransas). 1963. DIRECTIONS FOR THE DETERMINATION OF CHANGES IN CARBON DIOXIDE CONCENTRATION FROM CHANGES IN PH. Publications of the Institute of Marine Science, Vol. 9, pp. 454-489.

This is a methods paper describing a tonometer apparatus and procedures for the determination of changes in total carbon dioxide concentrations in waters from measurements of pH. Where pH changes in water result from the metabolic addition or subtraction of carbon dioxide, continuous records of metabolism may be obtained from pH recordings. The calculations are facilitated by tables and a computer program. A sample calculation is included. (Authors)

6666. Chadwick, Harold K. (California Dept. Fish and Game, Sacramento). 1964. ANNUAL ABUNDANCE OF YOUNG STRIPED BASS, ROCCUS SAXATILIS, IN THE SACRAMENTO-SAN JOAQUIN DELTA, CALIFORNIA. Calif. Fish and Game, 50(2):

69-99.

A tow-net survey procedure was developed to estimate the relative abundance of young-of-the-year striped bass each summer. The accuracy of several survey procedures was evaluated. Young bass abundance declined from a 1953-54 peak to a 1959 low and then increased to a 10-year high in 1962. No relationships were detected between young bass abundance and water temperature, water temperature fluctuations, run-off, salinity, light, or spawning stock size. However, the data were inadequate to make a definitive evaluation. A direct relationship between bass distribution and salinity and run-off was found, with bass being further upstream in years of low run-off and greater salinity intrusion. The results also indicate there is probably a direct relationship between abundance of young and year-class recruitment. (Auth.)

6667. Albrecht, Arnold B. (California Dept. Fish and Game, Sacramento). 1964. SOME OBSERVATIONS ON FACTORS ASSOCIATED WITH SURVIVAL OF STRIPED BASS EGGS AND LARVAE. Calif. Fish and Game, 50(2): 100-113.

Laboratory experiments indicated suspension of developing eggs by water movement enhances egg survival; low salinity (920-948 ppm chlorides) enhances egg and larval survival, and moderate salinity (4,595-4,740 ppm chlorides) is not detrimental; and eggs can survive in either constant or fluctuating water temperatures ranging from 55° to 75° F. Of the factors investigated, egg suspension is the most important for egg survival. Measurements indicated the mean specific gravity of striped bass eggs is approximately 1.0005, and is related to egg size, with larger eggs having a slightly lower specific gravity. Eggs are generally concentrated nearer the bottom at velocities less than one foot per second, while at greater velocities distribution is probably uniform. (Auth.)

6668. Van Arsdel, William C., III, and Carl E. Bond (Oregon State Univ., Corvallis). 1964. GRASS ROCKFISH, SEBASTODES RASTRELLIGER (JORDAN AND GILBERT) FROM THE YAQUINA BAY AREA, OREGON. Calif. Fish and Game. 50 (2): 125.

Several grass rockfish collected in Oregon indicate the species ranges 270 miles farther north in the Pacific Ocean than previously recognized. One specimen, 53 cm in total length, is one of the longest recorded. (Authors)

6669. Carlisle, John G., Jr., Charles H. Turner, and Earl E. Ebert (California Dept. Fish and Game, Terminal Island). 1964. ARTIFICIAL HABITAT IN THE MARINE ENVIRONMENT. Calif. Dept. Fish and Game, Fish Bull. 124: 1-93.

Biologist divers, designed, studied (using SCUBA), and evaluated artificial habitat as artificial fishing reefs, and studied the effects of offshore oil drilling installations to determine if they were beneficial or deleterious to the marine environment.

The ultimate aim of artificial reefs is to improve sportfishing in generally barren coastal waters for small boat fishermen. Thigmotropism, schooling behavior, shelter, and food are all important in the success of artificial habitat in improving fishing.

A replication experiment, utilizing car bodies, streetcars, concrete shelters and quarry rock, indicated that quarry rock and concrete shelters probably are the best for artificial reefs, with quarry rock costing about half that of 5 x 8 x 2 1/2 foot concrete shelters in this area. Automobile bodies, and to a lesser extent, streetcars, provide good, low-cost reefs for about 3 or 4 years.

Large fishes appear first on artificial reefs, which act as collecting stations; later as the reefs approach natural conditions, plant and animal populations exhibit fluctuations similar to natural reef eco-systems. Semi-resident fishes of the area make up most of the artificial reef or oil installation populations. A naturally-seeded kelp bed on a car body reef added considerably to its success. Oil installations were beneficial to the fauna and flora. Washed drill cuttings deposited on the bottom were not deleterious to marine life in the area. (Authors)

6670. Kholodov, Yu. A., and K. B. Akhmedov (Moscow State Univ., USSR). 1962. THE EFFECT OF CERTAIN PHYSICAL FACTORS ON THE SENSITIVITY OF FISH. Biologiya Belogo morya (Biology of the White Sea), Vol. 1, Moscow, pp. 256-261; (Translation: U. S. Dept. of Commerce, Off. of Tech. Serv., Washington, D. C., Publ. OTS 62-11771, price $. 50).

The influence of some physical factors, such as illumination, temperature, sound, and magnetic fields, on the reactions of fish in a constant electrical field are investigated. As the strength of an electric current is increased, the reaction of fish to this stimulant passes through five stages. The investigation is limited to the first two stages, which occur at low current strength. The reduction of illumination (darkening) reduces the sensitivity of fish to electric current. The extent of the reduction of this sensitivity depends on the species characteristics of the fish. The sound of an electric bell, heating of the water to 28° C, and a constant magnetic field reduce the sensitivity of stickleback to electric current.

6671. Kholodov, Yu. A., and G. L. Verevkina (Moscow State Univ., USSR). 1962. EFFECT OF A CONSTANT MAGNETIC FIELD ON CONDITIONED REFLEXES IN MARINE FISH. Biologiya Belogo morya (Biology of the White Sea), Vol. 1, Moscow, pp. 248-255; (Translation: U. S. Dept. of Commerce, Off. of Tech. Serv., Washington, D. C., Publ. OTS 62-11771, price $. 50).

Threespined stickleback, river flatfish, and fourhorned goby were employed to develop a conditioned reflex toward a magnetic field and also to trace the influence of the field on previously developed light and sound conditioned reflexes. In the

case of the stickleback, it was possible to develop with the constant magnetic field a conditioned inhibitor to a positive light reflex. A conditioned inhibitor due to a magnetic field was found to develop considerably faster than a positive conditioned reflex to light. The action of a magnetic field manifests itself also in the subsequent inhibition of conditioned reactions. The constant magnetic field inhibited defensive conditioned reflexes already worked out for light and sound in flatfish and goby. The enumerated properties of a magnetic field makes it necessary to assume that this stimulus has an unconditioned inhibitory effect on the higher nervous activity of fish.

6672. Brouillard, Keith D. (Bur. Comm. Fish. Econ. Off., U. S. Fish and Wildl. Serv., Ann Arbor, Michigan). 1963. ECONOMIC FACTORS RELATED TO LAKE TROUT QUOTAS ON LAKE SUPERIOR. Fishery Industrial Research, Vol. 2, No. 2, pp. 1-4.

In some fisheries, a quota on catch as a method of management has proved successful insofar as physical yield is concerned. This method, however, has been based primarily on biological concepts, with little concern for the economic aspects.

The philosophy of management should include a consideration of economic rent. This rent can be obtained by limiting costs--that is, effort--as well as by limiting production. The combination of a quota on catch and a limitation on amount of gear will produce both biological and economic benefits.

The lake trout fishery on Lake Superior presents an opportunity to apply economic as well as biological principles to the management of an entire body of water. If both of these factors are considered in the regulation of the fishery, the industry will be stronger in its long-term operations. (Auth.)

6673. Hunt, Robert L. (Wisconsin Cons. Dept., Box 450, Madison). 1964. EVALUATION OF FLY-FISHING-ONLY AT LAWRENCE CREEK. (A THREE-YEAR PROGRESS REPORT.) Wisc. Cons. Dept. Misc. Research Report No. 10 (Fisheries), 15 pp.

Slightly fewer anglers utilizing the zone (CD) restricted to fly-fishing creeled a slightly greater number of brook trout while fishing fewer hours than those anglers who fished in the any-lure zone (AB). The flies-only zone normally contained more legal-sized trout before and after the fishing season. Angling exploitation was low but similar in both zones. It never exceeded 12 percent of the preseason population.

Harvests were not determined by the methods of fishing but by interaction of the prevailing size limit of 8 inches, the amount of angling pressure, and densities of trout. The bag limit of 5 had little direct influence upon catches.

No differences in standing crops, survival rates, reproductive capabilities, or growth of trout in the two fishing zones could be directly related to differences in fishing methods. If any benefits or detriments did accrue they were masked by natural mortality. Bait-fishermen caught and released 40 percent of the preseason stocks without increasing total mortality.

Standing crops of older age-groups increased over the 3-year period, but the increases occurred in both zones. Light exploitation in both zones plus above average overwinter survivals were responsible for the increases.

Fly-fishermen were definitely attracted to Lawrence Creek by the flies-only regulation, and they had better fishing success than anglers had in the any-lure zone.

Seasonal patterns of angling pressure were similar in both zones but daily patterns were not. Fishing pressure in AB was heavy in the morning and very light after 5 p. m. Fishing pressure in CD was heavy in the afternoon and evening.

Although exploitation was low in both zones, the slightly higher proficiency of fly-fishermen indicates that application of a flies-only rule will not be sufficient to prevent overharvest of brook trout if angling pressure is heavy or density of trout is low.

In the management of our wild brook trout fisheries the most effective regulation over a wide range of angling pressure and trout density is the size limit. If this regulation is wisely applied, there is little biological need at present for either bag limits or restrictions on commonly accepted methods of angling. (Auth.)

6674. Makarewicz, W. (Dept. of Biochemistry, Medical School, Gdansk, Poland). 1963. AMP-AMINOHYDROLASE AND GLUTAMINASE ACTIVITIES IN THE KIDNEYS AND GILLS OF SOME FRESH-WATER VERTEBRATES. Acta Biochimica Polonica, Vol. X, No. 4, pp. 363-369.

The activities of AMP-aminohydrolase and glutaminase were estimated in the kidneys and gills of five teleost fish species and of the lamprey. Kidneys and gills of fishes possessed very active AMP-aminohydrolase; whereas, the activity of glutaminase was low, being of the order observed in higher animals. The activity of glutaminase in the gills was always lower than in the kidney. The possible role in various species of AMP and glutamine as precursors of the ammonia excreted, is also discussed. (Auth.)

6675. McNeil, William J. (Bur. Comm. Fish., Auke Bay, Alaska), and Warren H. Ahnell. 1964. SUCCESS OF PINK SALMON SPAWNING RELATIVE TO SIZE OF SPAWNING BED MATERIALS. U. S. Fish and Wildlife Serv., Special Scientific Report--Fisheries No. 469, 15 pp.

The potential of a salmon spawning bed to produce fry is directly related to its permeability. The relationship between the coefficient of permeability and the fraction of bottom materials consisting of fine particles is inverse.

Field methods for measuring size composition of bottom materials in salmon-spawning beds are described, and an empirical relationship between the fraction (by volume) of solids less than 0.833 mm minimum dimension and the coefficient of

permeability of stream bottom materials is given. Size of bottom materials in streams utilized for spawning by pink salmon (Oncorhynchus gorbuscha) varied considerably. The more productive spawning streams had the more permeable spawning beds. Adult pink salmon caused the removal of finer particles from bottom materials during spawning. The evidence indicates that the fine particles removed consist largely of organic matter. Logging caused fine sands and silts to accrue to spawning beds. Flooding caused the removal of fine particles from spawning beds. (Authors)

6676. Utter, Fred M., George J. Ridgway, and Harold O. Hodgins (Bur. Comm. Fish. Biol. Lab., Seattle, Washington). 1964. USE OF PLANT EXTRACTS IN SEROLOGICAL STUDIES OF FISH. U. S. Fish and Wildlife Serv., Special Scientific Report--Fisheries No. 472, 18 pp.

Seed and bark extracts representing 71 legume species were tested serologically against numerous individuals of the genus Oncorhynchus and a limited number of individuals from a broad taxonomic range of fish species. Many of these extracts demonstrated distinct individual variations in certain fish species. The possibility of distinguishing closely related fish species and their hybrids with some of the extracts was demonstrated. Red blood cells must be fresh when these extracts are used with Oncorhynchus species because marked alterations of reactions in this genus were found with aged red blood cells.

Eight of the extracts precipitated components of fish sera. Reaction of chinook salmon serum with Robinia pseudoacacia bark extract demonstrated significant variability in reactive frequency when tested against groups of individuals from Washington and Alaska. (Authors)

6677. Smith, Howard Donald (Fish. Res. Inst., Univ. of Washington, Seattle). 1964. THE SEGREGATION OF RED SALMON IN THE ESCAPEMENTS TO THE KVICHAK RIVER SYSTEM, ALASKA. U. S. Fish and Wildlife Serv., Special Scientific Report--Fisheries No. 470, 20 pp.

Groups of red salmon bound for specific spawning grounds in the Kvichak River system, Alaska, were studied to determine the extent of their segregation during migration up the river. Spawning groups were found to be intermingled to the extent that they could not be managed independently through the application of differential fishing pressure. (Auth.)

6678. Otsu, Tamio, and Richard N. Uchida (Bur. Comm. Fish., Washington, D. C.). 1962. MODEL OF THE MIGRATION OF ALBACORE IN THE NORTH PACIFIC OCEAN. U. S. Fish and Wildlife Service, Fishery Bulletin, Vol. 63, No. 1, pp. 33-44.

On the basis of tag recovery data, age and growth information, and distribution and size frequency data from the various fisheries, a model of the migration of albacore in the North Pacific Ocean has been developed. This model is consistent with the hypothesis that there is a single population of albacore in the North Pacific Ocean.

The model depicts extensive migrations of the albacore from one fishery to another and from one side of the North Pacific to the other side. In general it is shown that albacore recruitment into the commercial fisheries takes place largely in the eastern Pacific, and that there is a greater volume of migration of the commercial sizes of fish in the westerly direction from the American fishery into the Japanese fisheries, than vice versa. There is a tendency for the youngest fish in the American fishery to return to the same fishery the following season rather than to migrate across into the Japanese fisheries. This tendency is reduced in the older fish. Some albacore may be available to the American fishery for as many as four or five successive seasons.

As the albacore attain sexual maturity in temperate waters (6-year-olds and older) they move south into subtropical waters, where they make up the reproductive unit of the North Pacific population. This movement south takes place in the spring at the end of the Japanese winter longline season. It is hypothesized that spawning occurs in subtropical waters during the summer, and that the larval and early juvenile stages are spent in these waters. When about 1 year old, the fish migrate into temperate waters, but do not immediately join the exploited stock. The albacore are generally not available to the commercial fisheries until they are 2 or 3 years old. (Authors)

6679. Gauley, Joseph R., and Clark S. Thompson (Bur. Comm. Fish., Washington, D. C.). 1963. FURTHER STUDIES ON FISHWAY SLOPE AND ITS EFFECT ON RATE OF PASSAGE OF SALMONIDS. U. S. Fish and Wildlife Service, Fishery Bulletin, Vol. 63, No. 1, pp. 45-62.

The rates of passage of chinook (Oncorhynchus tshawytscha) and sockeye (O. nerka) salmon and steelhead trout (Salmo gairdneri) were studied in 1:16- and 1:8-slope, pool-and-overfall fishways. In general, the passage of salmonids through the 1:8-slope fishway with a 1.0-foot rise between pools was as fast as, or faster than, in the 1:16-slope fishway with a 1.0-foot rise. When the rise between pools was increased to 1.5 feet in the 1:8-slope fishway, chinook and sockeye were slower. The "Dalles-type" weir crests in a 1:16-slope fishway appeared to accelerate chinook passage. Chinook and sockeye displayed seasonal differences in times within the species. (Authors)

6680. Weaver, Charles R. (U. S. Bur. Comm. Fish., Washington, D. C.). 1963. INFLUENCE OF WATER VELOCITY UPON ORIENTATION AND PERFORMANCE OF ADULT MIGRATING SALMONIDS. U. S. Fish and Wildlife Service, Fishery Bulletin, Vol. 63, No. 1, pp. 97-121.

During the months of August and September 1957 a series of experiments were conducted at Bonneville Dam, to determine (1) how adult migrating salmonids

respond to differences in flow velocity, (2) how they perform in two relatively high-velocity flows, and (3) how the velocity of flow influences their rate of movement.

Given a choice of entering either of two parallel channels carrying flows of different velocities, steelhead trout (Salmo gairdneri), chinook salmon (Oncorhynchus tshawytscha), and coho salmon (O. kisutch) generally demonstrated a preference for the channel with the higher velocity flow. The magnitude of the response varied between species and with velocities of the choice condition.

The performances of steelhead trout and chinook salmon were examined in flow velocities of 13.4 and 15.8 feet per second by determining the distance they could achieve in an 85-foot channel. Although there was considerable variation in the distances attained by individual fish at each velocity, steelhead trout were generally more successful in negotiating these velocities than chinook salmon. Larger fish of both species were more successful in negotiating the two flows than smaller fish. Both species performed better in the 13.4 feet per second flow than in the 15.8 f. p. s. flow.

Rates of movement of steelhead trout, chinook salmon, and coho salmon were measured in velocities ranging from 2 to 15.8 f. p. s. Rates of movement varied with species, size of fish, and velocity. Maximum observed swimming speeds are given for each species and various factors affecting rate of movement are discussed. (Auth.)

6681. Monan, Gerald E., and Derek E. Engstrom (U. S. Bur. Comm. Fish. Biol. Lab., Seattle, Washington). 1962. DEVELOPMENT OF A MATHEMATICAL RELATIONSHIP BETWEEN ELECTRIC-FIELD PARAMETERS AND THE ELECTRICAL CHARACTERISTICS OF FISH. U. S. Fish and Wildlife Service, Fishery Bulletin, Vol. 63, No. 1, pp. 123-136.

A few of the electrical characteristics of fish were defined and studied as the criteria for producing a specific, observed reaction. Voltages and currents applied to a small test cell containing a live fish were measured. With the use of an electrical analogue of the cell contents, these data were reduced to the equivalent parameters applied to a mathematical model representing the fish. The resulting values of resistivity and power density computed for this model were then used to describe the corresponding fish characteristics. Application of pulsed voltages to the cell demonstrated a minimum power density below which no reaction was observed. Equations were then derived to relate this value to corresponding electrical conditions that would exist at an electrical guiding installation. (Authors)

6682. Sindermann, Carl (U. S. Bur. Comm. Fish., Washington, D. C.). 1962. USE OF PLANT HEMAGGLUTININS IN SEROLOGICAL STUDIES OF CLUPEOID FISHES. U. S. Fish and Wildlife Service, Fishery Bulletin, Vol. 63, No. 1, pp. 137-141.

As part of a general immunogenetic study of marine animals, the use of hemagglutinins in seed extracts has been investigated. Individual variations were found in reactions of alewife, blueback herring, and Atlantic herring erythrocytes with certain extracts, particularly those of lima beans. Reactions of Atlantic herring cells with one lima bean extract paralleled those found with certain rabbit antisera. Evidence was obtained for heterogeneity among four spawning populations of alewives with quantitative tests of erythrocyte antigens using an extract of one variety of lima bean. (Auth.)

6683. Nichols, Paul R., and William H. Massmann (Virginia Inst. of Marine Sci., Gloucester Point). 1962. ABUNDANCE, AGE, AND FECUNDITY OF SHAD, YORK RIVER, VA., 1953-59. U. S. Fish and Wildlife Service, Fishery Bulletin, Vol. 63, No. 1, pp. 179-187.

A study of the American shad fishery of the York River, Va., during 1959 showed an estimated total catch of 463,000 pounds, a fishing rate of 55.2 percent, and a total population of 839,000 pounds. Additional estimates of catch and effort were used to calculate fishing rate and population size for each year 1953 through 1958. Analyses of scales showed that most shad spawn at 3, 4, and 5 years of age and approximately 23 percent of the fish caught during the 1957-59 seasons had spawned the previous year. The number of ova produced by York River shad ranged from 169,000 to 436,000 per fish. (Authors)

6684. Ridgway, George J. (U. S. Bur. Comm. Fish., Washington, D. C.). 1962. DISTINGUISHING TUNA SPECIES BY IMMUNOCHEMICAL METHODS. U. S. Fish and Wildlife Service, Fishery Bulletin, Vol. 63, No. 1, pp. 205-211.

Interspecies differences in the sera of adult tuna (albacore, Thunnus alalunga; yellowfin, Thunnus albacares; bigeye tuna, Thunnus obesus; skipjack, Katsuwonus pelamis; little tunny (wavyback skipjack), Euthynnus yaito; and dogtooth tuna, Gymnosarda nuda) were demonstrated by double diffusion precipitation with antisera produced in rabbits. Studies of the soluble antigens extractable from the flesh of tuna were complicated by spontaneous precipitation. It was possible, however, to distinguish skipjack tuna from albacore and yellowfin by means of immunodiffusion of extractable tissue antigens. (Auth.)

6685. Collins, Gerald B., Carl H. Elling, Joseph R. Gauley, and Clark S. Thompson (U. S. Bur. Comm. Fish., Washington, D. C.). 1961. EFFECT OF FISHWAY SLOPE ON PERFORMANCE AND BIOCHEMISTRY OF SALMONIDS. U. S. Fish and Wildlife Service, Fishery Bulletin, Vol. 63, No. 1, pp. 221-253.

The effect of fishway slope on the performance and biochemical state of salmonids was studied in two experimental "endless" fishways with slopes of 1 on 8 and 1 on 16. A locking device in each fishway permitted recycling of fish so that pool-and-

overfall fishways of any height could be simulated. Ascents were generally confined to a rise of 104 feet, but a number of fish were permitted to ascend over several hundred feet and one fish was allowed to ascend over 6,000 feet. Principal species tested were chinook salmon (Oncorhynchus tshawytscha), sockeye salmon (O. nerka), and steelhead trout (Salmo gairdneri).

Comparisons of individual passage times, patterns of movement, and biochemical phenomena associated with muscular activity showed no evidence of fatigue of the fish in either fishway when proper hydraulic conditions existed. Data indicated that ascent of a properly designed pool-and-overfall fishway is only a moderate exercise for salmonids and that the rate of ascent will not decline in the upper end of a long fishway. Hydraulic conditions were shown to control rate of ascent and pattern of movement through fishways. Differences in rate of movement and in blood lactate levels were measured between species.

The effects of size, sex, maturity, and disease on performance and biochemical state of fish were also examined. Significant relationships were found only for length of male chinook and performance (larger fish were slower), and sex and blood lactate level for chinook (female chinook had higher blood lactate levels). (Authors)

6686. Tesch, F. W. 1961. EFFECT OF SEWAGE AND GROWTH OF FISH IN THE UPPER SAALE IMPOUNDING RESERVOIR (BLEILOCH RESERVOIR). Acta hydrobiol., 3, 151-164; Water Pollution Abstracts, Vol. 36, No. 11, Abst. No. 1796. 1963.

The author deals with the differences between natural lakes and impounding reservoirs and describes studies of fish growth in the upper Saale and the Bleiloch Reservoirs and the effects of variations in the flow of the river and in the amount of sewage on the fish population and the size of fish.

6687. Skrinde, R. T., J. W. Caskey, and C. K. Gillespie. 1962. DETECTION AND QUANTITATIVE ESTIMATION OF SYNTHETIC ORGANIC PESTICIDES BY CHROMATOGRAPHY. J. Amer. Wat. Wks. Ass., 54, 1407-1423; Water Pollution Abstracts, Vol. 36, No. 11, Abst. No. 1817. 1963.

In view of the increasing use of synthetic organic pesticides, there is a need for a suitable method for determining the types and amounts of traces of pesticides in water. Paper and gas chromatographic methods have been developed for analysis of pesticide residues in food products, and the possibility of adapting these techniques to water analysis is being investigated. Gas chromatography is likely to be more useful than paper chromatography, as the latter method is unable to separate large numbers of components and components of similar R_f values from a single sample, and in addition paper chromatograms are only semi-quantitative. Studies at Washington University, St. Louis, Mo., on gas chromatographic analysis of gamma BHC, using argon and electron capture ionization detectors, have shown that the sensitivity of detection increases as the voltage in the detector cell is decreased; experiments are still being continued on the application of this procedure to water supplies. A bibliography of 45 references is appended.

6688. Kadner, W. 1961. THE TREATMENT AND PURIFICATION OF MINE WATERS WITH HIGH CONTENTS OF IRON. Vom Wasser, 28, 131-145; Water Pollution Abstracts, Vol. 36, No. 11, Abst. No. 1865. 1963.

Difficulties caused in the Niederlausitz brown coal district of Germany by the high iron content of mine waters led to the formation of a committee to consider the treatment of the waters and the production of iron hydroxide suitable for gas purification. An illustrated description is given of a plant designed for two-stage treatment of the mine waters. In the first stage the water is treated with milk of lime, the preparation and distribution of which is described. After aeration and sedimentation the supernatant water passes to a storage tank before the second stage of treatment and the sludge to a two-stage concentration plant. For dewatering of the sludge, vacuum filters have been found most effective. The storage tank between the two stages of treatment of the water serves as a buffer tank. Lime water is added and the water is aerated before filtration for removal of the iron and manganese.

6689. Davis, J. J. 1962. ACCUMULATION OF RADIONUCLIDES BY AQUATIC INSECTS. U. S. Atom. Energ. Comm., HW-SA-2848, 14 pp.; Nuclear Sci. Abstr., 1963, 17, 730; Water Pollution Abstracts, Vol. 36, No. 11, Abst. No. 1890. 1963.

A survey has been made on the accumulation of radionuclides by aquatic insects in the Columbia River within the Hanford Reservation, Washington. More than 60 isotopes have been found in the waste waters discharged to the river, and about 20 of them have been measured in the river organisms. The insects in the river were found to be many times more radioactive than the water they inhabit. The most abundant nuclides found in insects were phosphorus-32, copper-64, chromium-51, zinc-65, and sodium-24. The most important factors effecting accumulation of nuclides by different species were found to be food habits, biological half-lives of the isotopes, and seasonal variation in feeding. Typical accumulation factor patterns are given for a number of immature and adult aquatic insects and also for plankton.

6690. Loshak, A. Ya. 1962. HYGIENIC EVALUATION OF RADIOACTIVE IODINE ACCUMULATION IN FRESH-WATER FISH. Hyg. & Sanit., Moscow, 27, No. 6, 93-95; Nuclear Sci. Abstr., 1963, 17, 738; Water Pollution Abstracts, Vol. 36, No. 11, Abst. No. 1891. 1963.

Experiments have shown that iodine-131 is taken up strongly from water by year-old carp; maximum uptake was reached after 2-3 weeks' exposure, and was retained at the same level during the remainder of the experiment.

6691. Nakatani, R. E., and R. F. Foster. 1963. EFFECT OF CHRONIC FEEDING OF SR-90-Y-90 ON RAINBOW TROUT. U. S. Atom. Energ. Comm., HW-SA-2255, 14 pp.; Nuclear Sci. Abstr., 1963, 17, 730; Water Pollution Abstracts, Vol. 36, No. 11, Abst. No. 1893. 1963.

Results are given of experiments on prolonged feeding of yearling rainbow trout with strontium-90-yttrium-90. Growth depressions and significant mortalities occurred in fish fed 0.5 μc per g of fish daily for 21 weeks, but other groups receiving lower concentrations (0.05 and 0.005 μc per g) did not differ from the control fish. A pronounced leukopenia was observed for the high-level treatment group at the end of the test. All treatment groups retained about 25 percent of the administered dose; the total body burden of a 309-g fish in the highest group was in the order of 2200 μc. At the end of the test no obvious damage was observed in the low and medium groups, but 6 months post-treatment leukopenia was indicated in the medium group. Effects observed in the high-dose group included anorexia, loss of weight, listlessness and a diminished response to external stimuli.

6692. Arnold, G. E. 1962. THERMAL POLLUTION OF SURFACE SUPPLIES. J. Amer. Wat. Wks. Ass., 54, 1332-1346; Water Pollution Abstracts, Vol. 36, No. 11, Abst. No. 1915. 1963.

With the vast amount of industry in Pennsylvania, increasing volumes of water are being used for cooling purposes and then discharged to streams and lakes. The State Sanitary Water Board, therefore, appointed a committee, with representatives from the water and sewage departments, general industry, electric power, fish and wildlife organizations, and public health authorities, to investigate the situation and make recommendations for regulations to control the discharge of heated wastes. The general committee was divided into several sub-committees, to deal with aspects affecting aquatic life and recreation, sewage, water, and the power industry, and the reports of these sub-committees are summarized. In addition, some field studies were carried out by various industries on several rivers in the state. From the data so obtained, the Sanitary Water Board formally adopted regulations limiting the discharge of heated wastes to an amount that could not raise the temperature of the entire stream at the point of discharge above 93° F, assuming complete mixing, except under special conditions where downstream conditions warrant a greater increase in stream temperature. However, these restrictions do not apply to streams so polluted with acid mine drainage that they cannot support a fish population, except for discharges which might adversely affect domestic or industrial use or secondary streams. A fishway must be provided in streams receiving heated discharges where this is essential for the preservation of migratory pathways for game fish or for important aquatic life. No new discharge will be permitted to waters providing a suitable environment for trout if, as a result of the discharge, the temperature of the receiving stream would exceed 58° F, or the normal temperature of the stream, whichever is the higher. The heat content of discharges to estuarine waters must be reduced where necessary to protect the public interest.

6693. Zhadanov, A. A., and L. V. Levshin. 1958. PROTECTION OF FOREST AND WATER RESOURCES IN THE USSR. (OKHRANA LESNYKH I VODNYKH BOGATSTV V SSSR.) Gosyurizdat. Moscow. 51 pp.; Referat. Zhur., Biol., 1959, No. 78095 K; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4263. 1964.

Organization of forestry in the USSR (division of forests into groups of various importance and purpose, collective farm and other forests, and their administration); regulations for utilization of the forests and responsibility for infringements (extracts from legislation); the laws concerning the secondary utilizations of forests (cutting and grazing in forests, apiculture, harvest of fruits and seeds, preparation of moss, etc.); legislation of the protection and methods of organizing hunting economy; laws on the exploitation of water reservoirs; fishing regulations; supervision of the protection of fish reserves, and on the cleanliness of the water reservoirs. (Courtesy NSF (PL 83-480) 1963)

6694. Lebedeva, G. D. 1963. EXPERIMENTAL INVESTIGATION OF THE EFFECT OF INACTIVE PHOSPHORUS ON THE ACCUMULATION OF P^{32} IN FISH. (EKSPERIMENTAL'NOE IZUCHENIE VLIYANIYA STABIL'NOGO FOSFORA NA NAKOPLENIE FOSFORA-32 V RYBAKH.) Radiobiologiya 3(3): 377-382; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4654. 1964.

Introduction of inactive P in the form of Na_3PO_4 in amounts 20-200 times greater than that contained in the Moscow City water supply into a radioactive P^{32} solution $(1 + 0.4) \cdot 10^{-7}$ c/l.) in which 1 yr. old carp were kept reduced the maximum accumulation of P^{32} in the bones of the fish by a factor of 2-6 and in their muscle tissue by a factor of 1.5-3.5. When inactive P was introduced in the same amounts of the form of Na_2HPO_4, the accumulation of P^{32} in the bone tissue was reduced by a factor of 3.5-10 and in the muscle tissue by a factor of 2.5-7. Addition of inactive P within the range of concentrations tested (1-10 mg/l.) to the water in the form of Na_2HPO_4 was approximately twice as effective in reducing accumulation of radioactive P in the tissues of fish as its addition in the form of Na_3PO_4. It is concluded that the method in question is not effective enough and too expensive for practical application, because the reduction of radioactivity in the tissues of fish achieved is insufficient and the amount of inactive P which must be introduced into the water is too large. (L. M. B.)

6695. Egami, Nobuo, and Etoh Hisami (Natl. Inst., Radiol. Sci., Chiba, Japan). 1962. DOSE-SURVIVAL TIME RELATIONSHIP AND PROTECTIVE ACTION OF RESERPINE AGAINST X-IRRADIATION IN THE

FISH, ORYZIAS LATIPES. Annot. Zool. Japan. 35(4): 188-198; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4682. 1964.

Doses smaller than 1000 r have no significant effect on the survival of fish, and those larger than 1000 r increasingly give rise to noxious effects: with 1000 or 2000 r some fish died within 10 days, while others died within 30 to 100 days; from 4000 to 64000 r are the so-called "dose-independent range", killing the fish nearly the same period of time; 128000 r, the largest dose used, killed the fish at once. When the fish are exposed to reserpine solution (100 mg/l) before and during the irradiation, its lethal effect is greatly reduced: most of the fish pre-treated with this agent could survive up to 36 days after irradiation, while controls died within 13 days. (Y. W.)

6696. De Sylva, Donald P. (Inst. Mar. Sci., Univ. Miami, Miami, Florida). 1963. POSTLARVA OF THE WHITE MARLIN, TETRAPTURUS ALBIDUS, FROM THE FLORIDA CURRENT OFF THE CAROLINAS. Bull. Mar. Sci. Gulf and Caribbean 13(1): 123-132; Biological Abstracts, Vol. 45, No. 3, Abst. No. 13101. 1964.

A postlarval specimen of the white marlin is described for the first time. Counts and proportional measurements are given, and the color pattern is described. A provisional key is given for the late postlarvae and early juveniles of the Western Atlantic species of the family Istiophoridae. (Auth.)

6697. Rekubratskii, V. A. 1962. ON ECOLOGICAL STEREOTYPES OF RESPONSE OF SOME FISH OF THE BLACK SEA. (OB EKOLOGICHESKIKH STEREOTIPAKH REAGIROVANIYA U NEKOTORYKH RYB CHERNOGO MORYA.) In: Voprosy ekologii. (Problems in ecology.) Vysshaya Shkola: Moscow. 5: 186-188; Referat. Zhur., Biol., 1962, No. 1I73; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4897. 1964.

Studies were made on food-getting and defensive behavior patterns in a number of fish species inhabiting the Black Sea. It was found that ecologically similar species exhibit similar types of behavior (ecological stereotypes of response) in similar biological situations.

6698. Bagenal, T. B. (Mar. Sta., Millport, Scotland). 1963. VARIATIONS IN PLAICE FECUNDITY IN THE CLYDE AREA. Jour. Mar. Biol. Assoc. United Kingdom 43(2): 391-399; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4963. 1963.

The fecundity of plaice Pleuronectes platessa L. was studied from 1956 to 1961 in the Clyde Area of Scotland by estimating the number of eggs in the ovaries prior to spawning. It was found that there was no change in fecundity as the spawning time approached, but there was a marked change between the 1956 and 1957 fecundity level of about 137 thousand eggs and the 1958 to 1961 level of between 157 and 161 thousand eggs. It was found that all age groups showed this change simultaneously and so could not be caused by a genetic change in the population. The only environmental cause that could be found was related to the fishing intensity. It was suggested that heavy fishing from 1956 onwards reduced the population, but the survivors had the same food supply and were then able to produce more eggs. This interpretation is consistent with fecundity investigations elsewhere, and suggests that variations in fecundity are part of a density dependent population regulating mechanism. (Auth.)

6699. Blagovidova, L. A. 1961. FORMATION OF THE BENTHOS OF THE NOVOSIBIRSK RESERVOIR DURING THE TIME OF ITS FILLING. (FORMIROVANIE BENTHOSA NOVOSIBIRSKOGO VODOKHRANILISHCHA V PERIOD EGO NAPOLNENIYA.) Tr. Biol. Inst. Sibirsk. Otd. Akad. Nauk SSSR 7. 91-102; Referat. Zhur., Biol., 1963, No. 6D238; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4969. 1964.

The Novosibirsk Reservoir was created in 1957 but even by 1958 the water had not reached the level planned for it. Observations on the formation of the benthos were begun in 1956. Because of the incomplete filling of the Reservoir, its hydrological conditions changed radically over a period of a year and this was reflected in the conditions under which the benthal organisms lived. For the first two years tendipedid larvae predominated on the flooded land; new biocoenoses were formed in the floodplain ponds and in the former streambed in which originally aquatic fauna predominated. In comparison with the first year of filling some increase was observed in the biomass of the benthos and there was a decrease in it only in flooded lakes; the average biomass of the benthos in the period from July to October was 7.0-22.0 g/m^2. In the lacustrine portion of the reservoir most of the benthos consisted of tendipedid larvae which, because of the emergence of the adults during the summer, did not provide fattening for the benthophagic fish.

6700. Carlander, Kenneth D. (Iowa State Univ., Ames, Iowa). 1963. AN AGE RECORD FOR TAGGED WALLEYE. Iowa Conserv. 22(5): 34; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4971. 1964.

A walleye (Stizostedion vitreum) tagged in April 1956 when 6 or 7 years old was caught by an angler in November 1962. Other tag records suggest a greater number of old walleyes than does scale ring analysis. (Auth.)

6701. Carlander, Kenneth D. (Iowa State Univ., Ames, Iowa). 1963. YELLOW BASS COMEBACK AT CLEAR LAKE? Iowa Conserv. 22(6): 44-45; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4972. 1964.

Yellow bass (Roccus mississippiensis) in Clear Lake, Iowa, declined in average maximum size from 9-10 inches in 1952-54 to 6-7 inches in 1958-61. Drought caused water levels to drop, reducing the lake area by 10% and volume by 25%, in this same time. Population density of yellow

bass increased. Water levels improved in 1962 and the average size of yellow bass increased about 1 inch. (Auth.)

6702. Dusart, J. (Inst. Ed. Van Beneden, Liege, Belgium). 1963. A CONTRIBUTION TO THE STUDY OF THE ADAPTATION OF TILAPIA (PISCES, CICHLIDAE) TO LIFE IN A POORLY OXYGENATED ENVIRONMENT. (CONTRIBUTION A L'ETUDE DE L'ADAPTATION DES TILAPIA (PISCES, CICHLIDAE) A LA VIE EN MILIEU MAL OXYGENE.) Hydrobiologia 21(3/4): 328-341; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4975. 1964.

The oxygen dissociation curve of the hemoglobin of Tilapia macrochir was determined. The hemoglobin of T. macrochir is quite similar to that of Opsanus tau. T. machrochir shows uneasiness in breathing only when oxygen concentration is as low as 9-4 mm Hg O_2. T. melanopleura shows the same uneasiness from 18-9 mm Hg O_2. T. macrochir and T. melanopleura are not harmed in the swamps by lack of oxygen but T. melanopleura does not appear as well adapted as T. macrochir. It appears that pollution by carbon dioxide cannot be very harmful to T. macrochir. (Auth.)

6703. Gromov, V. V. 1958. INFLUENCE OF INDUSTRIAL SEWAGE ON THE HYDROFAUNA AND FISHING IN THE CENTRAL KAMA. (VLIYANIE STOCHNYKH VOD PROMYSHLENNYKH PREDPRIYATTI NA GIDROFAUNU I ULOVY RYB V SREDNEI KAME.) Vopr. Ikhtiol. 10. 172-187; Referat. Zhur., Biol., 1959, No. 71814; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4980. 1964.

The intensive pollution of the Kama River by sewage from the Krasnokamsk Industrial Center since 1936 has upset the hydrological, chemical, and especially the gaseous equilibrium of the river for 480 km. The rheophilic forms of benthos (some amphipods, insect larvae) died or decreased in number, thus reducing the biomass of benthos by a factor of 4 to 5 for 146 km. The underfeeding and poisoning of fish caused by the sewage, especially after 1940, significantly decreased the fish stocks of the Kama from Krasnokamsk to the Belaya River. The decrease in fishing causes losses of millions of rubles in two fisheries. (Courtesy NSF (PL 83-480) 1963)

6704. Hile, Ralph (U. S. Dept. Interior, Bur. Comm. Fish., Biol. Lab., Ann Arbor, Michigan). 1962. COLLECTION AND ANALYSIS OF COMMERCIAL FISHERY STATISTICS IN THE GREAT LAKES. Great Lakes Fish. Comm. Tech. Rept. 5. 1-31; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4981. 1964.

Catch-effort statistics are submitted on closely similar monthly report forms by licensed commercial fishermen throughout U. S. and Canadian waters of the Great Lakes. This form was tested experimentally in State of Michigan waters in 1926; monthly submittal was required of Michigan fishermen beginning September 1927. Use of the form spread gradually to other states and Ontario; full coverage was achieved in 1950. The procedure for tabulation and analysis of the statistics also is the same in all states and Ontario. Much of the present report is concerned with the development of the analytical procedure and the illustration, through example, of its operation. An early discovery was the need for completely independent tabulations of effort for each of the principal species. To meet this need, effort was changed to a species only on those days when some poundage was produced. At about the same time, it was learned that the catch per lift of stationary gear, without any consideration of fishing time (nights out) before lifting, gives satisfactory estimates of fluctuations in abundance. Later developments were concerned mostly with the use of catch-effort statistics for dissimilar gears to obtain single index figures for abundance and fishing intensity. The procedure now employed is described and illustrated. Special circumstances have made necessary certain exceptions to the standard procedure. Exceptions made to date are listed and the reasons for them explained. Explanations are given also of certain special computational problems, and the disruptive effects of changes of regulation are reviewed. (Auth.)

6705. Kononov, V. A., N. S. Menyuk, and A. M. Paradnikov. 1961. THE DNEPR RESERVOIR. (DNEPROVSKOE VODOKHRANILISHCHE.) Izvest. Gos. Nauchn.-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 50: 132-146; Referat. Zhur., Biol., 1963, No. 6D246; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4984. 1964.

The reservoir was filled from 1931 to 1934, and again in 1948. Its maximum depth is 60 m, average depth 8.4 m. The annual fluctuation in level is from 3.5 to 4 m. After installation of the Kremenchug Hydroelectric Station, the level has remained constant. The speed of the current varies from 1.3 m/second in the upper reaches to 0.01 m/second in the portion adjacent to the dam, where temperature stratification reaches 4.5-9.5° C. The oxygen conditions are favorable, but in some places considerable contamination by industrial wastes, leading to the death of fish, is observed. The mud layer has averaged 1.5 m in thickness for 10 years. In the upper reaches, and in the bays, hard aquatic plants have developed, while in the undrained shallow areas, there are soft aquatic plants. The biomass of the zooplankton increases with increasing nearness to the dam; it averages about 2.4 g/m^3. In the benthos oligochaetes are most numerous; the biomass (without mollusks) in different areas and at different times varies from 1.7 to 103.0 g/m^2. The most important commercial fishes are the bream, the blue bream (Abramis balleries), the wild carp, and the chekhon (Pelecus cultratus). These fish appear to be growing well. The total catch in 1956 was 13, 500 metric centners.

6706. Kruglova, V. M., and E. A. Berval'd. 1961.

THE VESELOVSK RESERVOIR. (VESELOVSKOE VODOKHRANILISHCHE.) Izvest. Gos. Nauchn.-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 50: 167-182; Referat. Zhur., Biol., 1963, No. 6D245; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4986. 1964.

The Veselovsk Reservoir is the middle one of the series on the salt river Zapadnyi Manych. Filling of the reservoir took place between 1932 and 1942. In 1942 the dam was broken and not filled again until 1948; it began to be freshened by water from the Kuban River. The reservoir has an area of 25,000 ha; its average depth is 3.6 m, maximum depth 9.6 m. There is negligible fluctuation in the level. As the water in the reservoir becomes fresher it tends to change from sulfate to carbonate-sulfate and from sodium to sodium-calcium. In conformity with the two phases of composition of the reservoir's water, two stages, saline and fresh, are observed in the development of the flora and fauna. Before the water became fresher, the phytoplankton consisted of 123 species and varieties among which the diatoms and blue-green algae predominated; the average biomass was 232 mg/m^3. After the water had become fresher, the composition of the phytoplankton went down to 68 species and Protococci were most numerous. Among the zooplankton there was a gradual decline in the previously dominant brackish-water forms; in spring Cyclops spp. are dominant, in summer Bosmina longirostris, and there is mass development of cladocerans. The development of the bottom fauna is related to the formation of the aquatic vegetation. When the water from the Kuban River began to enter, all vegetation disappeared and new species began to appear--Typha latifolia, Scirpus lacustris, and others. In the first year the bottom fauna consisted of about 50 forms and species of animals, chiefly tendipedid larvae. The average biomass in May was 32.73 g/m^2. In years when the mineral content was high 30 forms were observed and there was vigorous development of Cordylophora caspia which subsequently disappeared with further increases in the salt content. A year after the penetration of Kuban River water the average biomass of the benthos was 1.4 g/m^2. Then the species content of the bottom fauna increased to 70 forms, principally because of tendipedid larvae. To enrich the food supply for fishes, mysids, cumaceans, corophiids, and polychaetes (11 species) from a floodplain lake of the Caspian type were introduced. They flourished and became part of the fish diet. The most important commercial fishes are the wild carp, bream, pike-perch, goldfish, and ruffle. The growth rate of the fishes is fairly good. The reservoir is important for growing semimigratory fishes and as a valuable commercial fish-raising area.

6707. Lapitskii, I. I. 1961. THE TSIMLYANSK RESERVOIR. (TSIMLYANSKOE VODOKHRANILISHCHE.) Izvest. Gos. Nauchn.-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 50: 102-118; Referat. Zhur., Biol., 1963, No. 6D247; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4987. 1964.

The reservoir has been in existence since 1952. Its area is 270,000 ha; its maximum depth is 30 m; its average depth 8.8 m. There are considerable fluctuations in the level, which varies from one year to the next and prevents the development of littoral macrophytes which form the substrate for fish spawning. In summer almost complete homothermy is observed. In spring diatoms are most numerous among the phytoplankton; in summer it is Protococci; and from August onward, blue-green algae. The biomass of zooplankton reaches 4.4 g/m^3. The zoobenthos, which consists of 75% chironomid larvae, is subject to sharp seasonal changes because of the emergence of insects in summer; its maximum is reached in the fall. To supplement the fish food, Lower-Don mysids have been introduced. The most numerous fishes are bream, wild carp, blue bream, pike, and white bream. When a number of fishery improvements are made, the reservoir will produce wild carp, bream, and zander, and annual fish production will be 110,000 metric centners.

6708. Makeev, D. B. 1961. THE DNEPRODZERZHINSK RESERVOIR. (DNEPRODZERZHINSKOE VODOKHRANILISHCHE.) Izvest. Gos. Nauchn.-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 50: 119-131; Referat. Zhur., Biol., 1963, No. 6D244; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4989. 1964.

This reservoir will be located in the Dnepr Valley on a tract between the village of Romanovo and the line of direction of the Kremenchug Hydroelectric Station at the village of Taburishche on the Dnepr alluvial plain. The area of the reservoir at a normal head of water (64 m) is 56,700 ha; its volume is 2.45 km^3. The average depth is 4.32 m, maximum depth is 17 m, and average width is 4.3 km; its length is 140 km. The author describes the hydrochemical and hydrological conditions of the area of the Dnepr at the site of the future reservoir, its plankton and benthos, and higher aquatic plants. Because the conditions for fish are so favorable, fish production of 60 kg/ha for the new reservoir is predicted. The annual catch will be 10 times as great as the present catch. The stocks of fish in the reservoir will take 6 years to form.

6709. Ozhegova, V. E., and V. A. Maksunov. 1961. THE FARKHAD RESERVOIR. (FARKHADSKOE VODOKHRANILISHCHE.) Izvest. Gos. Nauchn.-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 50: 248-260; Referat. Zhur., Biol., 1963, No. 6D234; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4996. 1964.

The reservoir was constructed on the Syr-Dar'ya River in 1947. It is 36 km long, has an area of 4600 ha, a maximum depth of 23 m and an average depth of 6.9 m. Because of the high turbidity of the Syr-Dar'ya River, the reservoir had become silted up to 71% of its capacity by 1953, and was converted to a wide portion of the river.

The annual fluctuation in the water level is never more than 0.5-0.7 m. The average monthly water temperature varies from a low of 2.6-6.9° C to a high of 23-24°. The oxygen regime is favorable. Macrophytes grow vigorously in the reservoir, but there is poor development of phytoplankton (diatoms and green algae). Among the zooplankton, which grows intensively only in summer, forms of the lake-pond complex are predominant. Limnophilic tendipedids predominate in the benthos, which is divided into 3 biocoenoses; those on the clay of the river deposits, the dark-gray clay of the flooded soils, and the clumps of macrophytes. The average biomass of the benthos does not exceed 1 g/m^2 in spring and summer; in fall it is 3.5 g/m^2. There are 26 species of fishes, among which the carp are dominant. The external appearance of the fish and their growth rate are not as good as in other reservoirs. In 1959 the fish production was 450 metric centners. Half of the catches consisted of wild carp. Because the water is clearer since the construction of the Kairak-Kumsk Reservoir, it is proposed to acclimatize Varicorhinus capoeta and the grass carp (Ctenopharyngodon idella).

6710. Penáz, Milan (Vertebratological Lab., Czechoslovak Acad. Sci., Brno, Czechoslovakia). 1962. CRITICAL CONTRIBUTION TO THE METHODS OF EVALUATING THE BODY-SCALE RELATION IN STUDIES OF GROWTH IN FISHES. Zool. Listy 11(1): 77-80; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4998. 1964.

This paper deals with the ratio of body length to size of scale. It is concluded that there is no reliable method for judging this ratio or drawing conclusions from it as to growth rate of the scales. (A. K. W.)

6711. Petkevich, A. N. 1961. THE NOVOSIBIRSK RESERVOIR. (NOVOSIBIRSKOE VODOKHRANILISHCHE.) Izvest. Gos. Nauchn.-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 50: 197-212; Referat. Zhur., Biol., 1963, No. 6D239; Biological Abstracts, Vol. 45, No. 2, Abst. No. 4999. 1964.

The Novosibirsk Reservoir was formed by regulation of the flow of the upper part of the Ob' River and was filled from 1957 to 1959. At maximum head its area is 107,000 ha; its volume 8.8 km^3; its depth at the streambed from 15 to 28 m; the drop in water level 5 m. The hydrochemical condition of the new reservoir is favorable; the water is mineralized and has a weakly alkaline reaction. There were only a few kinds of plankton in the Ob' River; in the reservoir the greatest development has been that of the diatoms in the flooded bogs, while Cladophora have developed most in the littoral region. The zooplankton population increased in the reservoir over that in the river; the biomass in the first year varied from 8.5 to 2697 mg/l: this was greater than in the river, but less than in the floodplain lakes. The bottom on the flooded land has been settled chiefly by tendipedid larvae. In the first year the areas of flooded forests, shallows, flooded lakes and bays had a fairly abundant benthos; by fall the biomass was about 13.32 g/m^2. In the second year the biomass of the benthos varied from 7 to 22 g/m^2, and the number of bivalves and oligochaetes increased. The author predicts the formation of the fauna in the future in different areas of the reservoir. The regulation of the current has had a negative effect on the natural production of sturgeon and inconnu; construction of a fish hatchery and the other measures are suggested, which may raise the productivity of fish to 14-15 kg/ha. The period of formation of commercial stocks of fish living exclusively in rivers (roach, pike, ide) lasts 5-6 years; for sturgeon it is 8-10 years.

6712. Rybak, Jan Igor (Inst. Inland Water Fish., Olsztyn, Poland). 1962. THE NATURE OF DEVELOPMENT OF CRUSTACEAN PLANKTON IN FINGERLING PONDS ORGANICALLY FERTILIZED. (CHARAKTER ROZWOJU PLANKTONU SKORUPIAKOWEGO W NAWOZONYCH ORGANICZNIE STAWACH PRZESADKOWYCH.) Rocz. Nauk Rolniczych Ser. B. Zootech. 81(2): 291-305; Biological Abstracts, Vol. 45, No. 2, Abst. No. 5005. 1964.

Barnyard manure fertilization of primary nursery ponds created better developmental conditions for Daphnia longispina than green (rye and vetch) fertilization. No clear differences were found in the development of Cladocera and Copepoda at the respective stations. Turning over heaped barnyard manure in one pond produced a stronger development of zooplankton which was dominated by Bosmina longirostris. The population of Copepoda diminished greatly. (Auth.)

6713. Sakowicz, Stanislaw, and Andrzej Kompowski (Inst. Inland Water Fish., Olsztyn, Poland). 1962. FISH EGGS AS FOOD OF ORCONECTES LIMOSUS RAF. (IKRA RYB W POKARMIE RAKA PREGOWATEGO (ORCONECTES LIMOSUS (RAF.)).) Rocz. Nauk Rolniczych Ser. B. Zootech. 81(2): 377-388; Biological Abstracts, Vol. 45, No. 2, Abst. No. 5006. 1964.

The crayfish Orconectes limosus was brought to Europe from North America by the end of the past century and since then has been spreading in the fresh waters of Poland. Many fishery biologists believe that this species is harmful under local conditions and it is claimed that, among other things, it drives out other crayfish species and has a harmful effect upon fishes. The object of the present work is to establish whether this opinion is correct, and, in particular, to investigate the feeding of Orconectes limosus on roe. The research material was collected from spawning areas of Coregonus albula in Wdzydze Lake in the middle of December of 1957 and 1958, and in February 1958, as well as from roach spawning areas, at the end of May 1958. Length measurements of O. limosus were made from the top of the rostrum to the edge of the telson. The age was determined by Peplov's method (1938). The examination of the content of alimentary tracts was concentrated particularly on roe. A total of

514 specimens were examined, including 421 specimens caught in the spawning areas of C. albula and 93 in roach spawning areas. The food of O. limosus consists mainly of submerged plants. Food animals were found in barely 12.9% of the specimens with filled alimentary tracts. Of the specimens of O. limosus from spawning areas of C. albula, the roe was found only in 20 (4.75%). Either undamaged eggs or only shell membranes were found in the alimentary tracts. This may prove that the crayfish swallow whole eggs without crunching them. A general and detailed examination showed that there was no selection of C. albula roe by O. limosus. In spite of the presence of abundantly deposited roach roe, none was found in the alimentary tracts of the examined crayfish. Their food at that time consisted almost exclusively of plants. O. limosus does not cross-breed with Potamobius, owing to a different structure of reproductive organs preventing copulation. Moreover, it does not represent food competition for Potamobius. Although it feeds mainly on submerged plants, there are usually ample supplies of that kind of food in water bodies. Moreover, O. limosus is ecologically no competition for other crayfish species. The above facts show that the opinions concerning the harmful effect of Orconectes limosus on fishes and other crayfish species in Polish conditions should be revised. (Authors)

6714. Sal'nikov, H. E. 1961. THE KAKHOVSK RESERVOIR. (KAKHOVSOE VODOKHRANILISHCHE.) Izvest. Gos. Nauchn-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 50: 147-166; Referat. Zhur., Biol., 1963, No. 6D243; Biological Abstracts, Vol. 45, No. 2, Abst. No. 5007. 1964.

The reservoir was filled in 1955 and 1956. It is 250 km long, has an area of 2155 km^2, a maximum depth of 38 m, an average depth of 8.4 m, and its annual fall is 2.3-3.9 m. The hydrochemical conditions are typically eutrophic. Tall aquatic plants do not develop well. In spring most of the biomass of phytoplankton consists of diatoms; in summer, of blue-green algae. The zooplankton content is higher than in the Dnepr before the latter was dammed (from 0.17 to 2.10 g/m^3); it rises in summer on the floodplain portions to 10.45 g/m^3. The benthos is nonuniform. Dreissena has settled everywhere in the reservoir in large numbers. The benthos varies from 2.5 to 36.5 g/m^2; in the lower part, owing to the mollusks, it reaches 990 g/m^2 by fall. To increase the food supply 36,000,000 invertebrates have been imported from the Dnepr floodplain. Intensive use of the benthos is made by the fish, but they do not consume enough of the zooplankton. The reservoir contains 47 species of fishes. In 1956 and 1957 the bulk of the commercial catches consisted of bleak, white bream (Blicca bjoerkna) and pike.

6715. Smirnov, A. F. 1961. THE LAKE VYG RESERVOIR. (VYGOZERSKOE VODOKHRANILISHCHE.) Izvest. Gos. Nauchn.-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 50: 7-18; Referat. Zhur., Biol., 1963, No. 6D242; Biological Abstracts, Vol. 45, No. 2, Abst. No. 5010. 1964.

The Lake Vyg Reservoir was formed in 1932 on the lake of the same name by damming the lower Vyg River. The area of the reservoir is 115,900 ha; maximum depth is 19 m, but the depth is usually 7-8m; the total watershed area is 19,080 km^2. The greater part of the watershed area consists of bogs. The reservoir water is little mineralized; its reaction is slightly acidic. The crustacean plankton consists of 20 species and forms of cladocerans, and 8 of copepods. The rapid rise in the water level has led to the destruction of the benthal fauna of the littoral and the dying out of mollusks and of the entomostracan Pontoporeia, but there has been greater development of tendipedid larvae, ostracods and others and Chaoborus larvae have appeared. As a whole, the biomass of the benthos increased during the first years of the reservoir: in 1940 it was 15.6 kg/ha, as contrasted with 13 kg/ha in the lake. Then the fauna of the littoral regenerated and by 1949 the average biomass of the benthos was about 15 kg/ha. Fifteen species of fishes live in the reservoir, of which ciscoe (Leucichthys allala) are most numerous. At present, the salmon, ciscoes, some forms of whitefish, pike, roach, bream, ide, burbot, pike-perch, perch, and ruff live in the reservoir; the bleak, fresh-water sculpin, minnow, stickleback, and grayling have disappeared. Intensive formation of a salmon stock began from young of the Atlantic salmon left in the reservoir after construction of the dam. Features of the distribution and biology of all the fishes living in the reservoir are given and a decrease in the catches is noted; this is caused by contamination with sewage and a sharp decrease in the number of fishermen.

6716. Stepanova, N. A. 1961. THE KATTA-KURGANSK RESERVOIR. (KATTA-KURGANSKOE VODOKHRANILISHCHE.) Izvest. Gos. Nauchn.-Issled. Inst. Ozernogo i Rechnogo Rybn. Khoz. 50: 234-247; Referat. Zhur., Biol., 1963, No. 6D235; Biological Abstracts, Vol. 45, No. 2, Abst. No. 5012. 1964.

The reservoir has been in existence since 1941. Its area is 66 km^2, volume 662,000,000 m^3, maximum depth 22 m and average depth 10 m. Because of the high turbidity of the river which feeds it, it has become severely silted with clay fractions. The water temperature varies from a low of 0-2° C to a high of 24-27°. In summer there is temperature stratification with a drop of 9°. The gas conditions are favorable. The amount of organic matter in the water is from 2.5 to 7.8 mg/l. There are almost no macrophytes. Over a period of years the plankton and benthos of the reservoir have become more varied. Maximum development of plankton occurs in summer and fall (up to 37.1 cm^3/m^3). The benthos consists mostly of oligochaetes and tendipedids; the average biomass usually does not exceed 2 g/m^2. Twelve species of fishes live in the reservoir; those of commercial importance are the wild carp and the Aral shemaia (Chalcalburnus chalcoides aralensis). Every year mirror carp are planted. To increase

the fishery importance of the reservoir, fisheries improvement measures must be carried out.

6717. Tabb, Durbin C. (Inst. Mar. Sci., Miami, Florida). 1960. THE SPOTTED SEATROUT FISHERY OF THE INDIAN RIVER AREA, FLORIDA. Florida Bd. Cons. Tech. Ser. 33. 1-20; Biological Abstracts, Vol. 45, No. 2, Abst. No. 5013. 1964.

Descriptions of the sport and commercial fisheries for 1955-58 are given. Cynoscion nebulosus is popular for anglers because of its wide range in inshore waters, year-around availability, desirable food value and eagerness to take a lure or bait. Live bait is more effective. As much as 90% of the sport catch is sold. There is little competition for choice fishing areas between sport and commercial fishermen because of urbanization and local legislation against netting. Gill netting and trolling are the main commercial fishing methods. Before 1952 commercial landings were largely a by-product of the gill net fishery for striped mullet. Since then, seatrout landings have been determined by prices and the market. A downward trend in production is attributed to decreasing commercial fishing effort and deleterious, man-made changes in the marine environment. (Auth.)

6718. Vasil'ev, I. S. 1958. WATER SUPPLY OF THE REDDS OF PINK SALMON AND SUMMER CHUM SALMON. (VODOSNABZHENIE NERESTOVYKH BUGROV GORBUSHI I LETNEI KETY.) Nauchn. Dokl. Vysshei Shkoly Biol. Nauk 3. 26-31; Referat. Zhur., Biol., 1960, No. 2086; Biological Abstracts, Vol. 45, No. 2, Abst. No. 5015. 1964.

By observing the movement of an electrolyte discharged into the river it was possible to determine the velocity and direction of the underground flow supplying the spawning grounds of pink salmon and summer chums. In fall, the average velocity of the underground stream past egg masses of pink salmon is 3.68 m/hour, and for summer chums it is 1.24 m/hour. This velocity depends on the hydrology of the parts of the river where the spawning grounds are. Pink salmon spawn on bars at a lesser depth and in a faster current than summer chums. Its spawning grounds are less liable to be covered with mud; the bottom is coarser. The water supply to the spawn decreases from the fall to the spring since, owing to the lowered water level in the river and accumulation of mud, the velocity of the underground stream decreases. The temperature of pink salmon eggs under the bars is determined by that of the river bed, but the temperature reaches that of the river-bed water after some delay. The gaseous conditions for the development of salmon are associated with the water supply and depend on the velocity of flow of water in the bottom and on the distance traversed by the underground flow without its mixing with the river-bed stream. Eggs situated nearer the bars, therefore, have a higher O_2 content and lower CO_2. (Courtesy NSF (PL 83-480) 1963)

6719. Moss, Melvin L. (Coll. Physicians and Surg., Columbia Univ., New York, N. Y.). 1963. THE BIOLOGY OF ACELLULAR TELEOST (FISH) BONE. Comparative biology of calcified tissue, 1962. Ann. New York Acad. Sci. 109(1): 337-350; Biological Abstracts, Vol. 45, No. 2, Abst. No. 5820. 1964.

The microscopic structure and its variations, and the processes of histogenesis of the acellular (nonosteocyte-containing) bone of the higher teleost fish is compared with the cellular (osteocyte-containing) bone of the lower teleosts. Preliminary biochemical and biophysical analyses of the flat bones, vertebrae, fin rays, and scales are reported for an extensive series of marine fish (tropical, temperate and arctic). A correlation is suggested between these data and the Ca concentrations of the specific environmental waters, as was reported for several calcifying invertebrates. Emphasis is placed upon the role of fish bone in the geochemistry of marine Ca and P. Studies dealing with the physiological role of acellular and cellular bone are reported. Skeletally-stored minerals in acellular bone are relatively unavailable. The essentially negative results of attempts to use mammalian parathomone and dihydrotachysterol (AT-10) to alter serum Ca levels or to produce bone resorption are reported. Studies of the role of the hypophysis in Ca homeostosis were negative. The phylogenetic adaptive significance of the "neoevolution" of this tissue type is considered. (Auth.)

6720. Scarpelli, D. G., Marie H. Greider, and Walter J. Frajola (Dept. Pathol., Ohio State Univ., Columbus, Ohio). 1963. FINE STRUCTURE AND ENZYME PATTERN OF LIVER CARCINOMA AND ADENOMA IN RAINBOW TROUT. In: 47th Annual Meeting of the Federation of American Societies for Experimental Biology, 1963. Fed. Proc. 22(2 Pt. 1): 194; Biological Abstracts, Vol. 45, No. 2, Abst. No. 6293. 1964.

6721. Goncharov, G. D. 1962. IMMUNOLOGICAL REACTIVITY IN FISH. (IMMUNOLOGICHESKAYA REAKTIVNOST' U RYB.) Byul. Inst. Biol. Vodokhranilishch Akad. Nauk SSSR 12. 53-56; Referat. Zhur., Biol., 1963, No. 6I84; Biological Abstracts, Vol. 45, No. 2, Abst. No. 6661. 1964.

The formation of specific antibodies in fish (carp, bream, and roach) did not take place at a low water temperature (6-7° C). At a temperature of 16-25° C, specific antibodies were produced in the blood serum of the fish.

6722. Lumsden, Richard D. (Rice Univ., Dept. of Biol., Houston, Texas). 1963. A NEW HETEROPHYID TREMATODE OF THE ASCOCOTYLE COMPLEX OF SPECIES ENCYSTED IN POECILIID AND CYPRINODONT FISHES OF SOUTHEAST TEXAS. Proc. Helminthol. Soc. Washington 30(2): 293-296; Biological Abstracts, Vol. 45, No. 2, Abst. No. 8341. 1964.

Ascocotyle (Leighia) chandleri, a precociously developed metacercaria encysting in the liver of

Cyprinodon variegatus and Mollienesia latipinna at Galveston Bay, Texas, is described. It is distinct from previously described spp. of the genus Ascocotyle, primarily in possessing branched diverticula along the lateral post-testicular margins of the excretory vesicle. (Auth.)

6723. Frolov, Yu. P. 1958. THE FUNCTION OF THE SENSE ORGANS OF FISH IN DIFFERENT ECOLOGICAL CONDITIONS AS A FACTOR IN THEIR BEHAVIOR. (POVEDENIE RYB V ZAVISIMOSTI OT FUNKTSII IKH ORGANOV CHUVSTV V RAZLICHNYKH EKOLOGICHESKIKH USLOVIYAKH.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 8. 15-22; Referat. Zhur., Biol., 1959, No. 35093; Biological Abstracts, Vol. 45, No. 2, Abst. No. 8547. 1964.

The theoretical aspects of the peculiarities of fish behavior in connection with the function of the sense organs (vision, hearing, hydroacoustical and light localization and others) are described. (Courtesy NSF (PL 83-480) 1963)

6724. Korzhuev, P. A. 1958. ECOLOGICAL AND PHYSIOLOGICAL PECULIARITIES OF SOME FISH SPECIES. (EKOLOGO-FIZIOLOGICHESKIE OSOBENNOSTI NEKOTORYKH VIDOV RYB.) Tr. Soveshchanii Ikhtiol. Komis. Akad. Nauk SSSR 8. 364-371; Referat. Zhur., Biol., 1959, No. 49329; Biological Abstracts, Vol. 45, No. 2, Abst. No. 8550. 1964.

The average quantity of blood in the minnow is 1.9% of the body weight, 4.1% in the catfish, and 4.4% in the garpike. Hemoglobin concentration was 14g% in the striped bonito, 7.9g% in the pike, 7g% in hybrids between the wild carp and the scaled and mirror carp, 6.9g% in the minnow, 2.6g% in the plaice and 1.9g% in the ray. Hemoglobin content per kg of body weight was 2.4 g in hybrids of the carp and wild carp, 2.3 g in the garpike, 1.8 g in the catfish, 1.5 g in the pike, 1.4 in the sevan trout (Salmo ischchan), 0.7 g in the ray and 0.5 g in the plaice. The amount of hemoglobin is highest in very active fish (carp, wild carp, garpike, trout, etc.) and lowest in inactive fish (ray, plaice). The musculature amounts to 65.6% of the body weight in the striped bonito, 56.7% in the sevan trout and about 50% in the other fish. The weight of the heart is 0.31% of the body weight in the bonito, 0.18% in the carp and wild carp hybrids, 0.13% in the sevan trout, 0.12% in the minnow and gudgeon, 0.10% in the gudgeon. (Courtesy NSF (PL 83-480) 1963)

6725. Kusakina, A. A. 1962. CORRELATION BETWEEN TEMPERATURE-TOLERANCE OF PROTOPLASMIC PROTEINS AND ENVIRONMENTAL TEMPERATURES. (O SOOTVETSTVII TEPLOUSTOICHIVOSTI PROTOPLAZMATICHESKIKH BELKOV TEMPERATURNYM USLOVIYAM SUSHCHESTVOVANIYA VIDA.) In: Voprosy ekologii. (Problems in ecology.) Kievsk. Univ.: Kiev. 4: 45-46; Referat. Zhur., Biol., 1962, No. 9I45; Biological Abstracts, Vol. 45, No. 2, Abst. No. 8555. 1964.

A study of temperature-tolerance of isolated cells in allied spp. and populations made it possible to suggest temperature-tolerance as a sp. criterion for poikilothermal animals. Temperature-tolerance is higher in representatives of more thermophilic groups; consequently, evolutionary adaptation to temperature is achieved also on the cell level. A study was made of temperature-tolerance of cells and of cholinesterase in 10 species of fish from Baikal Lake. With respect to environmental temperatures, the fish under investigation can be divided into 3 groups: inhabitants of well-warmed shallow waters, inhabitants of the open parts of Lake Baikal, and representatives of the fauna from flood-plain lakes. Temperature-tolerance of muscles and of cholinesterase was found to be highest in spiny loach (Cobitis taenia) and minnows, lower in fish from flood-plain lakes, and lowest in deep-sea gobbies. Temperature-tolerance in muscles decreased in the following order: minnow> spiny> loach> roach> perch> Baikal sculpin> yellowfin Baikal sculpin> red Baikal sculpin> broadfinned humped sculpin> speckled sculpin. Cholinesterase temperature-tolerance decreased in the same order and was found to be lowest in "golomanka" (Comephorus, a Baikal fish related to the sculpins). A correlation was established between environmental temperatures and protoplasmic proteins. Adaptation to environmental temperatures is also observed on the molecular level in the study of stability indexes (characteristics of protoplasmic proteins).

6726. Unnithan, R. Viswanathan (Indian Ocean Biol. Center, Council of Scientific and Industrial Res., Ernakulam-6, India). 1964. FOUR NEW POLYONCHOINEANS (MONOGENOIDEA) PARASITIC ON GILLS OF MARINE FISHES FROM THE INDIAN SEAS. The Journal of Parasitology, Vol. 50, No. 2, pp. 241-247.

Four new species of monogenetic trematodes belonging to four different families of the subclass Polyonchoinea Bychowsky, 1937, are described. They are Diplectanum narimeen sp. n. of the family Diplectanidae Bychowsky, 1957, parasitic on Lates calcarifer (Bloch); Neocalceostoma arii sp. n. of the family Calceostomatidae (Par. and Per. 1890) Price, 1937, parasitic on Arius sp.; Tylosuricola panikkari gen. et sp. n. of the family Tetraonchidae Bychowsky, 1937, parasitic on Tylosurus leiurus (Blkr.); and Amphibdella narcine sp. n. of the family Amphibdellatidae (Carus, 1885) Bychowsky, 1957, parasitic on Narcine timlei (Bloch and Schn.). Heavy infestation by these gill trematodes was noticed except for Diplectanum narimeen sp. n. (Auth.)

6727. Fischthal, Jacob H., and Robert E. Kuntz (Dept. of Biol., Harpur Coll., State Univ. of New York at Binghamton, Binghamton, N. Y.). 1964. DIGENETIC TREMATODES OF FISHES FROM PALAWAN ISLAND, PHILIPPINES. PART I. FAMILIES ACANTHOCOLPIDAE, ANGIODICTYIDAE, CRYPTOGONIMIDAE, FELLODISTOMIDAE, AND GYLIAUCHENIDAE. The Journal of Parasitology, Vol. 50, No. 2, pp. 248-252.

New host and distribution records are reported from marine fishes from Palawan Island, Philippines,

for Stephanostomum casum (Linton, 1910) McFarlane, 1934 (Acanthocolpidae) from Lutjanus rangus; Hexangium sigani Goto and Ozaki, 1929 (Angiodictyidae) from Siganus striolatus, S. oramin (new distribution record only), and Stolephorus commersoni; Paracryptogonimus manilensis Velasquez, 1961 (Cryptogonimidae) from Lutjanus fulviflamma; and Gyliauchen papillatus (Goto and Matsudaira, 1918) Goto, 1919 (Gyliauchenidae) from Anodontostoma chacunda. Measurements are presented for all species. Paracryptogonimus orientalis sp. n. is described from Lutjanus fulviflamma, differing from all members of the genus in having an acetabulum appreciably larger than the oral sucker. Propycnadenoides philippinensis gen. n., sp. n. (Fellodistomidae) is described from Gymnocranius griseus, differing from closely related Pycnadenoides Yamaguti, 1938, in possessing an acetabulum with a traverse aperture and muscular lips of lamellar structure. (Authors)

6728. Fischthal, Jacob H., and Robert E. Kuntz (Dept. Biol., Harpur Coll., State Univ. of New York, Binghamton). 1964. DIGENETIC TREMATODES OF FISHES FROM PALAWAN ISLAND, PHILIPPINES. IV. SOME IMMATURE DIDYMOZOIDAE, A BUCEPHALID; A NEW HEMIUROID GENUS AND SUBFAMILY. The Journal of Parasitology, Vol. 50, No. 2, pp. 253-260.

Three immature didymozoids are reported from fishes of Palawan Island, Philippines: Torticaecum nipponicum Yamaguti, 1942, from Elotris fusca; immature Didymozoid A from Puntius binotatus; and immature Didymozoid B from Euthynnus yaito. A review of didymozoids listed as Distomum fenestratum Linton, 1907, in the U. S. National Museum Helminthological Collection resulted in their separation into two distinct forms: D. fenestratum from Gymnothorax moringa, Haemulon plumieri, H. sciurus, H. parra, Remora remora, Scorpaena sp., and Pseudupeneus maculatus; and immature Didymozoid C from Brevoortia tyrannus, Ammodytes americanus, and Etrumeus sadina. Bucephaloides sibi (Yamaguti, 1940) Hopkins, 1954 (Bucephalidae) is reported from Euthynnus yaito; and Pelorohelmins palawanensis gen. n., sp. n. (Hemiuroidea) from Gazza minuta is described. A new subfamily, Pelorohelminthinae, is created for the latter genus and appears to be most closely related to the family Isoparorchiidae. (Authors)

6729. Tiews, K. 1964. DER THUNBESTAND (THUNNUS THYNNUS (LINNAEUS)) IN DER NORDSEE, SEINE WANDERUNGEN, SEINE TRANSATLANTISCHEN BEZIEHUNGEN UND SEINE NUTZUNG DURCH DIE DEUTSCHE FISCHEREI. Archiv für Fischereiwissenschaft, Vol. 14, No. 3, pp. 105-148.

The paper presented deals with results of the German tuna research obtained during the latest research period, from 1959-1962. During this period the fishing conditions on the traditional German fishing grounds in the western part of the middle North Sea were found to have deteriorated.

During the research period from 1952-1955, a single year-class (1941 resp. 1942) dominated the catches. A surprisingly uniform catch composition was found during the years 1955-1962, when a fish of 12-13 years of age was predominant. During the last 7 years the North Sea stocks of tuna have been recruited with a surprisingly great regularity.

Tagging experiments indicate clearly a close relationship between the North European tuna occurrence and that on the Iberian coast as well as on the American Atlantic coast. It is not possible to distinguish the East and West Atlantic tuna occurrences by means of meristic characters, as a comparison of all data published in this respect shows. Only the Mediterranean tuna population seems to differ from the others by a greater number of both dorsal and ventral finlets. However, further investigations are necessary in this respect and should be extended to gill raker counts which are lacking for Mediterranean tuna.

Two returns of tuna, which had been tagged on the American side of the Atlantic and which had been recaught on the Norwegian coast after a period of less than 2-3 months, permits the conclusion that fish which have just crossed the Atlantic are in a very lean feeding condition. On the basis of this observation, a first attempt has been made to calculate the rate of stock exchange between both sides of the Atlantic Ocean by means of the proportion of lean fish on the total German tuna catch. The feeding condition of a fish is given by its feeding coefficient $K = (\text{weight} : \text{length}^3) \cdot 100$. The total materials available for this purpose amount to about 22,600 K-data which were collected from the German tuna catches from 1951-1962. On the basis of these results, which are in general agreement to the tagging experiments, it might be assumed that the remarkable change in the age composition of the German tuna catches for 1952 and 1953 is possibly related to the immigration of fish from the American side of the Atlantic, which have become stationary on the European side of the Atlantic in the following years. The considerable increase of the Norwegian tuna catches during the year 1961, when again remarkably many lean tuna were caught (33%), may possibly also be related to the immigration of fish from the western side of the Atlantic. This time the fish were 11-13 years old. From the high average value of 12% for the proportion of lean tuna in the catches during the entire research period from 1952-1962, it might be concluded that a transatlantic migration of tuna in an east-west direction is likely, at least to a certain degree.

6730. Mohr, H. 1964. NETZFARBE UND FANGIGKEIT BEI KIEMENNETZEN. Archiv für Fischereiwissenschaft, Vol. 14, No. 3, pp. 153-161.

In a fresh-water lake in northern Germany, a test was conducted during a whole year with gill nets of different colors. The species of fish observed differed widely in their ecology and rhythm of diurnal activity.

In the case of the vendace (Coregonus albula) the color itself was obviously of no influence, but only its depth. All nets, of various colors, caught

practically the same amount of vendace, but the uncolored, white net caught considerably less. An explanation for this color-blind reaction of the vendace is that it lives in deeper water and is mainly active in dusk and dawn, when most animals react color-blind.

The perch (Perca fluviatilis) is a fish of the shallower regions and it hunts mainly in daytime. Therefore, the color is very important for the efficiency of a net. In the warm season the efficiency decreased from green $\geq$ red > brown > black > blue > white > yellow. In winter green lost its efficiency to an extent, whereas brown and black became more favorable. The reactions of roach (Leuciscus rutilus) were similar to that of perch. Yet in great shoals the "shoal pressure" masked the avoiding-reaction to an unfavorably colored net.

The efficiency of certain colors, and the change due to the seasons, can be explained by the coincidence with vegetation and zooplankton of the same color.

6731. Foerster, John W. (Dept. of Biol., North Texas State Univ., Denton). 1964. AN INEXPENSIVE ADAPTATION FOR PLANKTON NETS. Turtox News, Vol. 42, No. 1, pp. 22-23.

An inexpensive collecting device for coupling a collecting bottle to a plankton net is described. A 2-4 ounce polyethylene plastic bottle is utilized for the collection bucket. Taking the cap of one of these bottles and drilling or cutting the top out is the first step. Next, the remaining cylinder with only the knurled grooves left is placed in the receiving end of the net. Around the end of the net and the drilled cap is placed a thumbscrew type radiator hose clamp which is tightened until no slippage occurs. The plastic bottle is placed into this fitting. Cost of this adaptation runs less than fifty cents per net.

6732. Yoshioka, Hiroshi (Faculty of Fisheries, Hokkaido Univ., Hakodate, Japan). 1963. ON THE EFFECTS OF ENVIRONMENTAL FACTORS UPON THE REPRODUCTION OF FISHES. Bulletin of the Faculty of Fisheries, Hokkaido Univ., Vol. 14, No. 3, pp. 137-151.

Pairs of Oryzias latipes were kept under artificial photoperiods during the breeding season at 18° C-21° C. The following conclusions were drawn from the experiments: (1) Inhibition or acceleration of spawning in the fish kept under artificial photoperiods is not related to "the decreasing or increasing change" in illumination time, but to "lower or higher level in amount" of illumination time. (2) The critical length of illumination time to maintain the spawning in this species is estimated at between 12 and 13 hours of light per day. (3) The females kept under day-lengths of less than critical values stop laying eggs within 20 days. When they were returned to the condition of day-length higher than the value, they began to lay eggs within 10-17 days. (4) Feeding activity, ovulation, and oviposition take place normally under artificially shortened day-lengths. (5) Oocytes above 420 μ in diameter are inhibited in growth by artificially shortened day-lengths.

6733. Sukhoverkhov, F. M., R. V. Krymova, and V. G. Farberov. 1963. THE EFFECT OF COBALT UPON THE GROWTH AND HEMATOLOGICAL INDICES OF CARP. Rybnoye Khozyaystvo (Fisheries), Vol. XXXIX, No. 8, Moscow, pp. 35-38. (Translated: U. S. Dept. of Commerce, OTS 63-41127, The Soviet Fishing Industry, pp. 8-11, price $.75.)

Experiments were designed to study the effect of cobalt upon the growth and physiological condition of carp two-year-olds and yearlings over a three-year period in the experimental ponds of the Niva Fisheries in Voronezh Oblast. The addition of cobalt salt to the feed mixture at the rate of 0.02-0.08 milligrams per 1 kg of live weight of fish per day has a decided effect upon the physiological condition of carp yearlings and two-year-olds, improving the blood indices in regard to erythrocytes, leucocytes, and hemoglobin. By raising the metabolic level in carp, larger commercial fish (16 to 30 percent by weight) were reared, and feed outlays per unit of growth of two-year-olds were reduced by an average of 20 percent.

6734. Davis, Gerald Evert (Ph. D. Thesis, Oregon State Univ., Corvallis). 1963. TROPHIC RELATIONS OF SIMPLIFIED ANIMAL COMMUNITIES IN LABORATORY STREAMS. Dissert. Abstracts, Vol. XXIV, No. 8, p. 3469. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-2354, 96 pp. (Microfilm $2.75; Xerography $5.00).

This study was concerned with some of the trophic relations of simplified animal communities in six laboratory streams, each having an area of 1.25 square meters. The work was carried on between 1960 and 1962 at the Pacific Cooperative Water Pollution and Fisheries Research Laboratories, Oregon State Univ. Herbivorous food organisms, chiefly midge larvae and mayfly nymphs, naturally colonized the streams and subsisted on periphyton growing on rubble and gravel placed in the streams. Different biomasses of sculpins (Cottus perplexus) and different combinations of biomasses of sculpins and stonefly naiads (Acroneuria pacifica) were added to the streams to study relationships between biomass and competition in carnivore production. A herbivorous snail (Oxytrema silicula) was added to utilize periphyton in competition with the herbivorous insects present in the streams.

Production of the stocked animals during an experimental period was estimated from changes of their biomass, since mortality was usually not a factor. The relationships between growth rates and food consumption rates were established for sculpins, stonefly naiads, and snails in aquaria during each experimental period. Estimates of food consumption by the animals in the streams were made on the basis of stream growth rates and the growth-food consumption relations established in aquaria. These food intake or yield values were used to estimate food organism production in streams in which

it was believed that food organisms were utilized to the extent that they did not accumulate and death, emergence, and export would be insignificant. Biomass units were converted to energy terms using combustion calorimetry values determined for the animals and periphyton.

During the first year, sculpin production at six levels of sculpin biomass was studied. Production was low in streams with low biomass, highest at intermediate biomasses, and again low at higher biomasses. Growth rates were highest at low biomass levels, declining markedly with increases of biomass. Low production at low biomass levels no doubt resulted from the restricted amount of new tissue which a small biomass could elaborate. Sufficient biomass was present at intermediate levels to convert the available food to production. At the highest biomass levels the greater proportion of food energy was required for maintenance of a larger and probably more active sculpin biomass, but, in addition, food organism production may have been reduced through overcropping.

In the fall, 1961, experiment, low and high sculpin biomasses were placed in different streams. A high stonefly biomass was added to streams having both low and high sculpin biomasses. Large biomasses of snails were also added to streams having low and high sculpin biomasses. Two remaining streams with low and high sculpin biomasses were used as controls. The addition of snails did not affect sculpin production, since snail biomasses were not large enough to reduce the amount of food energy available to the food organisms. Sculpin production was positive and was similar in streams containing sculpins alone and sculpins and snails. Sculpin production was negative in both streams containing stonefly naiads, the greatest reduction occurring at the high sculpin biomass level.

Sculpins were stocked at low, intermediate, and high biomass levels during the winter, 1962, experiment. A low and a high stonefly biomass was added at each of the sculpin biomass levels. Small snail biomasses were added to all six streams. Sculpin production increased slightly and remained quite high with increases of sculpin biomass at the low stonefly stocking level. Sculpin production decreased markedly with increases of biomass at the high stonefly stocking level. Increases of stonefly biomass had a stronger reducing effect on sculpin production than did increases of sculpin biomass. Stonefly naiad production increased with decreases of sculpin biomass but declined quite markedly with increases of stonefly biomass.

Production of the periphyton was estimated. This information, along with animal production values, made possible the calculation of trophic level production efficiencies, pathway efficiencies and ecological growth efficiencies. An energy flow diagram was used to express the energetic relationships in the six streams during the winter, 1962, experiment. Of 5293 kilocalories per square meter of net production, 5270 kilocalories could be accounted for by plant decomposition, herbivore consumption, removal of sampled material, exported plant materials and by plant materials which accumulated during the experimental period. (Auth. abst.)

6735. DeWitt, John William, Jr. (Ph. D. Thesis, Oregon State Univ., Corvallis). 1963. EFFECTS OF POLLUTIONAL CONDITIONS ON STREAM ORGANISMS WITH ESPECIAL EMPHASIS ON STONEFLY NAIADS. Dissert. Abstracts, Vol. XXIV, No. 9, p. 3507. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-2356, 232 pp. (Microfilm $3.00; Xerography $10.60).

Artificial streams with continually renewed river water flowing over natural bottom materials in wooden troughs and often circulated by means of pumps to increase velocities were used to study experimentally the effects of pulp mill wastes on stream ecology. Representative stream animals were subjected in these streams, usually for two weeks or one month, to different concentrations of sulfite process pulp mill waste liquor, which was added constantly to the influent water; some were held likewise in unpolluted water with dissolved oxygen concentrations either normal or reduced by means of nitrogen. The long-term resistance of the organisms to harmful effects of the wastes, including reduction of dissolved oxygen alone, thus was evaluated. The utility of artificial streams in the identification of specific causes of death of animals in variously polluted waters was explored, and also their utility in the development of "toxicity bioassay application factors" intended for facilitating regulation of discharges of toxic wastes of predetermined acute toxicity. The principal test animals were stonefly naiads of the genus Acroneuria, but other invertebrates and fish were also tested.

Both sulfite and kraft wastes produced striking changes in the artificial streams. A "slime" composed largely of Sphaerotilus natans sometimes completely blanketed bottom materials. Under the slime blanket, dissolved oxygen was greatly reduced. The variety and numbers of algae were much reduced in the presence of either waste. Perhaps because of the marked toxicity of kraft waste, neither chironomids nor cladocerans, which sometimes became numerous in streams receiving sulfite waste, were ever abundant in streams receiving kraft waste. Tested concentrations of kraft waste less than one-tenth the 24-hour median tolerance limit for young guppies (fish) at 20° C did not increase the mortality rates of stonefly naiads nor cause much slime growth, whereas greater concentrations did.

Increased mortality of insects in the presence of kraft waste apparently was due largely to toxicity of the waste, but other factors, such as reduced dissolved oxygen, may have been partly responsible. Increased mortality in sulfite waste experiments was due largely to reduced dissolved oxygen, but probably in part also to some other factors, such as toxicity of the waste or slime growth on the insects, which may interfere with respiration. These conclusions are based on observed relationships between mortality rates of the insects and dissolved oxygen and waste concentrations in streams receiving the wastes and supplied with natural water or

water that had been treated (oxygenated) with oxygen gas. They are based also on comparisons of curves relating mortality rates to the lowest recorded oxygen concentrations in these polluted streams and in streams with unpolluted water whose oxygen content had been suitably adjusted.

The low-oxygen tolerance of Acroneuria naiads at temperatures ranging from 2.2 to 24° C and different water velocities was evaluated additionally through experiments wherein the animals were held (in cages) in tubular glass chambers with circulated water or in jars of standing water. The tolerance increased with increasing water velocity. The 24-hour median tolerance limits of reduced dissolved oxygen determined for A. californica naiads ranged from 0.6 mg/l at 2.2° C and 0.13 feet per second velocity to 3.7 mg/l at 24° C in standing water. Relationships between ventilatory movements, oxygen concentration, and water temperature were determined. Oxygen consumption rates at 20° C in standing water with widely varying oxygen concentrations were determined; they proved dependent on concentration even at levels near air-saturation.

The usefulness of artificial streams in studies of stream ecology and their limitations are fully discussed, and shortcomings of the reported experiments and some possible improvements are considered. (Auth. abst.)

6736. Putnam, Hugh Dyer (Ph. D. Thesis, Univ. of Minnesota, Minneapolis). 1963. A STUDY OF THE NUTRIENTS, PRODUCTIVITY, AND PLANKTON IN WESTERN LAKE SUPERIOR. Dissert. Abstracts, Vol. XXIV, No. 9, p. 3510. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-3579, 302 pp. (Microfilm $3.90; Xerography $13.75).

The investigation was carried out primarily during the summer from 1958-1961 in western Lake Superior. Results from the various determinations show that Lake Superior exhibits general oligotrophic characteristics. Nitrogen occurs principally as NO_3-N (mean: 0.40 ppm). Phosphorus levels (mean: 0.009 ppm) indicate that Lake Superior is a phosphorus-poor lake. Phosphorus occurs primarily in an organic form; inorganic phosphorus is barely detectable. The water, both surface and subsurface, generally is well oxygenated and is relatively soft (hardness 50 ppm or less). Results of chemical determinations for alkalinity, pH, silica and sulfate are also included.

A study was also made of nutrients contributed by a selected number or representative streams. Phosphorus levels were highest in the Wisconsin and Michigan tributaries along the south shore of Lake Superior (mean: 42.16 micrograms/liter). Stream nitrogen was present mainly in the organic form. Oxygen was high in all tributaries. Although the dissolved and suspended materials in tributary streams was higher than that observed in the lake, the total amount contributed by these streams was not enough to bring about a measurable increase in the lake.

Representatives of all the major algal phyla were found in the plankton. Diatoms were the most abundant at all depths. Asterionella formosa, Coccochloris, Cyclotella, Dinobryon, Fragilaria, Melosira granulata, Rhizosolenia, Synedra, and Tabellaria were the principal phytoplankters.

Measurements of the standing crop and estimates of the phytoplankton production were made by population counts, determination of plant pigments, and the isotopic carbon technique. Primary production at three lake stations based on the chlorophyll a concentration varied from 129 to 881 mg of carbon per square meter of surface per day. The most productive water was found at the extreme western end of the lake near Duluth. Carbon-14 fixation rates varied from 76 to 507 mg carbon/m^2/day. The C-14 fixation rate was highest in September.

Measurements of subsurface light intensity indicate that long wavelength solar energy (640-700 millimicrons) is absorbed in the upper few meters while blue light (wavelength 400 to 450 millimicrons) was detectable at 20 meters. Both Secchi disc and submarine photometer readings show Lake Superior to have a high water transparency. The average Secchi disc transparency was 10 meters and the mean depth of the photic zone (I_o = 1%) was 22 meters. (Auth. abst.)

6737. Cooper, Edwin Lowell (Ph. D. Thesis, Brown Univ., Providence, R. I.). 1963. THE EFFECTS OF ANTIBIOTICS AND X-IRRADIATION ON THE SURVIVAL OF SCALE HOMOGRAFTS IN FUNDULUS HETEROCLITUS. Dissert. Abstracts, Vol. XXIV, No. 9, p. 3890. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-1962, 67 pp. (Microfilm $2.75; Xerography $3.80).

All animals exhibit a characteristic phenomenon, biological specificity, which enables them to respond to foreign organic material. When a vertebrate is challenged with a tissue homograft, it is rejected by the immunological mechanisms of the host. This study is concerned with the homograft reaction in the teleost fish, Fundulus heteroclitus. Skin (scale) homografts were easily made by inserting donor scales into dermal scale pockets on hosts from which scales had been previously plucked. A simple quantitative estimate of graft survival was made by taking daily counts of the number of melanocytes on six scale homografts. At 28 + 1° C the end point of graft survival occurred maximally at three days as evidenced by the presence of numerous extracellular clusters of melanin, the only remaining components of the disrupted melanocytes.

Means by which the survival of homografts can be prolonged were exploited by the use of chemical and physical agents. Antibiotics were injected intraperitoneally in 0.1 cc quantities into the host at various times after making the grafts. Control fish received equal volumes of distilled water. Whole body x-irradiation was administered to anesthetized fish at dose levels from 500-300r. Unirradiated fish served as donors and controls.

The antibiotics, albamycin and neomycin sulfate, hardly affected the survival of homografts, while stylomycin and acti-dione prolonged the survival until the eighth and ninth days, respectively.

At 500r grafts survived one day past those of controls. At 1000-1500r survival of homografts was prolonged until the ninth and seventh days, respectively. When host fish were irradiated at 2000r and 3000r there was an increase in the number of deaths, due to the lethal effects of these dose levels. One fish irradiated at 2000r lived with grafts intact until the twenty-seventh day. The majority of cases irradiated at 3000r lived until the eleventh day with one exception, a fish that lived with the grafts intact until the fifteenth day.

When considering the effects of antibiotics and x-irradiation on the survival of scale homografts, a common mechanism of action appears to be operative. The results from studies utilizing mammals have demonstrated that x-rays inhibit the normal functioning of nucleic acids, especially DNA. However, the mechanism of action of the antibiotics remains more speculative. Acti-dione and stylomycin, which were effective in the present study, have been investigated in mammals and in other systems as well, such as Protozoa and plants. Differing (somewhat) from one system to another, the mechanism of action is always related in some way to the synthesis of nucleic acids and proteins. The results from investigations with albamycin and neomycin sulfate, both ineffectual in the current study, have not indicated any strong evidence that these compounds affect nucleic acid and/or protein synthesis in other systems.

The findings of this investigation add still more support to the contention that the nucleic acids lie at the basis of life processes. The synthesis of specific proteins, especially antibodies, is one example of the many kinds of biological specificity based on nucleic acids. (Auth. abst.)

6738. Cowell, Bruce Craig (Ph. D. Thesis, Cornell Univ., Ithaca, New York). 1963. A COMPARISON OF THE EFFECTS OF TWO AQUATIC HERBICIDES (SODIUM ARSENITE AND SILVEX) ON THE PLANKTON POPULATIONS IN CENTRAL NEW YORK FARM PONDS. Dissert. Abstracts, Vol. XXIV, No. 9, p. 3890. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-3664, 130 pp. (Microfilm $2.75; Xerography $6.20).

Many investigators have observed that aquatic plants seriously interfere with farm pond management or with the utilization of these waters. Chemical control of these aquatic plant nuisances has been used extensively throughout the United States, and various inorganic, organic, and metalorganic compounds have been screened for this purpose.

Although many of the chemicals used to control aquatic vegetation seem to be non-toxic to fish and other vertebrates, relatively little is known about their effects on other fresh-water organisms. This project was designed to compare the effects of two aquatic herbicides (sodium arsenite and silvex) on plankton populations, and to compare the effectiveness of these chemicals as control agents for aquatic weeds.

A method of constructing polyethylene barriers which effectively divide a pond into two similar areas was developed. With this technique, it was possible to compare treatment with treatment and treatment with control in the same pond, thereby eliminating the problem of variability between ponds.

A relatively new test statistic, sequential analysis, was adapted for research in aquatic weed control. This test statistic is extremely valuable in that it eliminates the necessity of pre-treatment sampling. Statistically valid conclusions can be obtained more rapidly, and a larger number of experiments may be conducted during one season.

Application of 4 ppm As_2O_3 as sodium arsenite effectively controlled filamentous algae (Cladophora, Spirogyra, and Zygnema) and pondweeds (Potamogeton) of the submerged species. Chara, Sagittaria, and Alisma were not controlled effectively by sodium arsenite.

Silvex at concentrations of 2 ppm effectively controlled Potamogeton and Lemna. The filamentous algae, Hydrodictyon and Spirogyra were controlled in two ponds, but satisfactory control of filamentous algae was not obtained in any of the other ponds treated with silvex. Chara and Alisma also were not affected by silvex and poor control of Sagittaria was recorded.

Within-pond comparisons of the plankton data from the summer of 1961 indicated that neither herbicide produced significant decreases in phytoplankton volumes. These comparisons also seemed to indicate that the application of silvex had little effect on the zooplankton, but the application of sodium arsenite caused a decrease in zooplankton volumes. However, these data represent changes occurring between sampling periods only, and cannot be used for making planned comparisons of control with treatment and treatment with treatment in different ponds. When paired observations were used to make such comparisons, no definite trends were observed. Rather, the data indicate that farm ponds are highly variable, even when carefully selected for similarities.

Much of this variability was eliminated by using polyethylene barriers during 1962. Comparisons of either control with herbicide or herbicide with herbicide could be made within any given pond with this procedure.

Sequential analyses of the phytoplankton data revealed that neither herbicide had any effect on the phytoplankton. Comparable volumes and species compositions were observed in samples taken from opposite sides of the polyethylene barrier in all ponds.

Sequential analyses of the zooplankton data revealed that silvex was neither toxic nor inhibitory to the zooplankton at concentrations of 2 ppm. Similar analyses revealed that the application of 4 ppm sodium arsenite caused drastic reductions in zooplankton volumes. Differences of between one and two orders of magnitude were recorded when rotifer volumes from areas treated with sodium arsenite were compared with those from control or silvex-treated areas of the same pond. Similar comparisons of copepodcladoceran volumes showed differences which ranged from 7-fold to approximately

one order of magnitude. Such differences were not observed in ponds in which comparisons of control with control and control with silvex were made.

6739. Richards, William Joseph (Ph. D. Thesis, Cornell Univ., Ithaca, New York). 1963. SYSTEMATIC STUDIES OF DARTERS FROM SOUTHEASTERN UNITED STATES (PISCES, PERCIDAE). Dissert. Abstracts, Vol. XXIV, No. 9, p. 3899. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-3654, 195 pp. (Microfilm $2.75; Xerography $8.80).

Part I. Description of a new percid fish, with a study of the subgenus Hadropterus. A new species of Percina from the Alabama River System is described and compared with P. nigrofasciata and P. sciera, the other two members of the subgenus Hadropterus. This new species has a distinctive color pattern and small scales (lateral line scales 77-90). The nomenclatural history of Hadropterus is reviewed and this subgenus is diagnosed and redescribed.

Part II. Systematics of the percid fishes of the subgenus Oligocephalus (genus Etheostoma) from the Atlantic drainages in Georgia and the Carolinas. Etheostoma fricksium, E. mariae, E. parvipinne, and E. hopkinsi (subgenus Oligocephalus) are found in Atlantic drainages in Georgia and the Carolinas. The first three form a natural species group in this subgenus while E. hopkinsi, though confused in the past with E. fricksium, is easily separable. Specific and infraspecific variation of morphological characters is investigated in E. fricksium, E. mariae, and E. parvipinne. E. mariae, which is confined to a small geographic area, exhibits little variation. E. fricksium shows slight variation while the wide-ranging E. parvipinne is very variable.

Part III. Systematics of the percid fishes of the Etheostoma thalassinum species group with comments on the subgenus Etheostoma. Etheostoma thalassinum from the Santee River System and E. inscriptum from the Altamaha, Savannah, and Edisto river systems are shown to be closely related species. The third representative of this group, E. swannanoa from the headwaters of the Tennessee River System, exhibits several specialized features. These include absence of palatine teeth, reduction in number of prevomerine teeth, and presence of a basal orange-red band in the spinous dorsal fin. These features among others relate this group to the E. blennioides group.

Sexual and temporal variation is studied in several large series of E. inscriptum. Only fin rays differed significantly in the sexes.

The subgenus Etheostoma is diagnosed and relationships of the species within this subgenus is discussed. (Auth. abst.)

6740. Gunning, Gerald E. (Dept. Zool. Psychol., Tulane Univ., New Orleans, Louisiana), and C. Robert Shoop. 1963. OCCUPANCY OF HOME RANGE BY LONGEAR SUNFISH, LEPOMIS M. MEGALOTIS (RAFINESQUE), AND BLUEGILL, LEPOMIS M. MACROCHIRUS (RAFINESQUE). Animal Behaviour 11(2/3): 325-330; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9444. 1964.

Size of home range in terms of linear feet of stream is estimated to be approximately 70 feet for the longear sunfish and approximately 125 feet for the bluegill. The longer a given sunfish is at large subsequent to fin-clipping, the greater is the tendency for this fish to stray outside the limits of a restricted segment. Older longear sunfish and bluegill appear to have larger home ranges than younger individuals. Bluegill strays tend to move upstream. Space-temporal aspects of home range must be considered concomitantly. Short-term occupancy of home range by longear sunfish and bluegill is easily demonstrable; continuous occupancy for a period of several months is difficult to prove in that the number of recaptures diminishes greatly with the passage of time. (Auth.)

6741. Herbert, D. W. M. (Water Pollution Res. Lab., Stevanage, England). 1963. REVERSAL OF DIRECTION OF SWIMMING BY RAINBOW TROUT (SALMO GAIRDNERII RICHARDSON) ON STOPPING A CURRENT OF WATER. Animal Behaviour 11(2/3): 347-350; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9448. 1964.

One-year-old rainbow trout of an autumn spawning strain, kept swimming for several months against a circular current of water, reversed the direction in which they swam when the current was stopped. The majority would continue swimming circuits of the aquarium in the new direction for more than 5 hours. Yearling rainbow trout kept swimming against the current from January, did not reverse their direction until the end of April, and the development of this behavior coincided with the loss of parr marks and the assumption of adult markings. Brown trout parr from an upland stream did not reverse their swimming direction when the circular current was stopped. For several weeks after the reversing behavior had developed, the sign of the response could be changed by submitting fish for about two days to a circular current flowing in the opposite direction, but at a later stage the direction taken by the fish when the current stopped appeared to become fixed. No reversal occurred if the current was stopped when the aquarium was in total darkness, nor if the fish could not see their surroundings for approximately 2 to 3 hours after a period of 1/2 hour in total darkness. Well-established swimming in the reversed direction through still water was abolished by 5 minutes in total darkness. (Auth.)

6742. Malyukina, G. A., S. P. Aleksandryuk, and M. Shtefanesku. 1962. ON THE ROLE OF VISION IN "SCHOOLING" BEHAVIOR OF MINNOWS (PHOXINUS PHOXINUS L.) AND GOLDFISH (CARASSIUS CARASSIUS L.). (O ROLI ZRENIYA V STAINOM POVEDENII GOL'YANOV (PHOXINUS PHOXINUS L.) I KARASEI (CARASSIUS CARASSIUS L.).) Vopr. Ikhtiol. 2(3): 511-516; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9456. 1964.

Fish in schools exhibit less movement and

consume less O_2 than isolated fish of the same species. This decrease in O_2 consumption is called the "group effect." The schooling behavior in 2 species from ecologically different habitats, P. phoxinus from fast-moving streams of high visibility and C. carassius from still waters of low visibility, was determined on the basis of their group effect. It was found that under lighted conditions, normal isolated P. phoxinus consumed up to 48.3% more O_2/gram-weight than when in groups of 6-8. In the dark, isolated and grouped fishes consumed the same amount of O_2 and there was no group effect. In both light and dark, isolated C. carassius consumed more O_2 than fish in groups. Enucleated P. phoxinus exhibited no group effect during the first few days, but exhibited increasingly greater group effect later on. Enucleated C. carassius showed a group effect throughout. Hence, vision is a secondary factor in the schooling behavior of C. carassius, but primary in that of P. phoxinus. A gradual return of the group effect in enucleated P. phoxinus is attributed to increasing function of other sensory systems, normally a secondary factor in schooling behavior. Differences in group effect and schooling behavior between the two species are attributed to ecological and physiological differences in their respective habitats. (L. T. P.)

6743. Beamish, F. W. H. (Dept. of Zool., Univ. of Toronto, Toronto, Ontario, Canada). 1963. RESPIRATION OF FISHES WITH SPECIAL EMPHASIS ON STANDARD OXYGEN CONSUMPTION. III. INFLUENCE OF OXYGEN. Canadian Journal of Zoology, Vol. 42, No. 3, pp. 355-366.

Standard oxygen consumption was determined in relation to various partial pressures of oxygen for eastern brook trout at 10° and 15° C, and for carp and goldfish at 10° and 20° C. Two conditions of oxygen acclimation were compared. In one case acclimation was to air saturation, while in the other acclimation was to each of the partial pressures of oxygen applied.

Down to a partial pressure of oxygen of approximately 80 mm Hg, standard oxygen uptake remained approximately constant, and further, the rates for the two differently acclimated groups were about equal. Below 80 mm Hg the standard rate first increased to a maximum and then, with a further reduction in the partial pressure, decreased. Below 80 mm Hg the standard rate of oxygen consumption was in all cases less for the fish acclimated to the low level of oxygen than for those acclimated to air saturation.

Comparison of standard and active values suggests that the increase in standard rate of oxygen uptake in response to low oxygen does not reach the active level as suggested earlier by Fry (1947). The suggestion is made that a fraction of standard metabolism is derived anaerobically in low levels of oxygen. Further, it appears that acclimation to a low level of oxygen enhances the anaerobic fraction of standard metabolism. (Auth.)

6744. Thomas, J. D. (Univ. of Ghana, Legon, Accra, Ghana). 1963. A COMPARISON BETWEEN THE HELMINTH BURDENS OF MALE AND FEMALE BROWN TROUT, SALMO TRUTTA L., FROM A NATURAL POPULATION IN THE RIVER TEIFY, WEST WALES. Parasitology, Vol. 54, No. 2, pp. 263-272.

Nine hundred and five brown trout were collected from the River Teify, West Wales, over a period of 12 months and their helminth infestations are considered in relation to the age and sex of the host and season.

Only one statistically significant difference could be detected between levels of infestation in male and female trout of 1 and 2 years of age.

When trout of 3 years of age and over were spawning or recovering from the effects of spawning there is a tendency for sexually mature females to be more heavily infested with some parasites than the males. During the season of growth and maturation of the gonads this trend was reversed or became less marked. In the case of fish that were not spent or spawning, the statistically significant differences showed the males to be more heavily infested than the females.

The possible reasons for these variations are discussed, with particular reference to the roles of 'physiological' and 'behavioral' or ecological resistance. (Auth.)

6745. Tranter, D. J. 1962. SCOR-UNESCO ZOOPLANKTON INTERCALIBRATION TESTS. 1st Series R. S. Vityaz, Australia, p. 4, 4 refs.; C. S. I. R. O. Abstracts, Vol. 12, No. 4, Abst. No. 333. 1964.

A comparison of the zooplankton samplers, the Jouday net, the Clarke-Bumpus, and the Indian Ocean Standard net, using 9 successful hauls with each net shows that the results with the Indian Ocean Standard and the Clarke-Bumpus sampler are comparable. There was a lack of consistency in the results of the Jouday net, but the variability was not excessive, and it is considered that, given a sufficient number of observations, results with this net are probably comparable with the other two.

6746. Isaacs, John D. (Scripps Inst. of Oceanogr., La Jolla, California). 1964. NIGHT-CAUGHT AND DAY-CAUGHT LARVAE OF THE CALIFORNIA SARDINE. Science, Vol. 144, No. 3622, pp. 1132-1133.

Some 70,000 larvae of the California sardine, Sardinops caerulea, collected from about 10,000 plankton hauls over the years 1950 to 1957, have been sorted by lengths and enumerated. The numbers of the day-caught larvae are very closely a numerical measure of the apparent mortality, as indicated by the night-caught larvae. Over a considerable interval of size, the night-caught larvae appear to be representative of the entire larval population, but the day-caught larvae may represent a fraction that is a measure of the natural mortality of the population. (Auth.)

6747. Pequegnat, Willis E. (Dept. of Oceanography

and Meteorology, Texas A & M Univ., College Sta.). 1964. THE EPIFAUNA OF A CALIFORNIA SILTSTONE REEF. Ecology, Vol. 45, No. 2, pp. 272-283.

Between 300 and 400 described species of macroscopic animals (including 22 fishes) were encountered on 1,385 m^2 of a siltstone, submarine hogback and adjacent mixed bottom located in the shallow sublittoral (9.5 to 18 m depth) about 500 m off the coast of Corona del Mar, California.

The components of the epifauna are not distributed uniformly over the reef. Both the numbers of species and individuals per unit area of reef surface vary inversely with depth. Although more species achieve maximum population densities at the top of the reef than elsewhere, some species are most abundant on the reef's mid-section, on the base, or on the rock-sediment bottom. Delineations among these major groups are sufficiently marked to warrant recognition of 3 vertical epifaunal zones on the reef itself and a 4th on the surrounding bottom within a meter of the reef base.

Although changing conditions associated with the highly irregular rocky surface create a high degree of patchiness in the epifauna, within any of the zones, some aggregations of species are sufficiently uniform and widespread to permit recognition of communities. In general, the predominant species in the upper 2 zones are sessile suspension feeders, which form thick incrustations that form biotopes for large numbers of small sessile and motile species. In the lower zones, on the other hand, the predominant species tend to be motile scavengers and deposit feeders, and the incrustations that are present are thin and formed by single species.

The degree of water movement on the reef, which results primarily from the propagation of surface waves, also varies inversely with depth. It is suggested that this pattern of water movement determines the distribution of the major units of the epifauna through its effects upon the availability of food of different types at particular points on the reef. Suspended organic matter is not only more abundant on the upper levels of the reef, but its rate of delivery to crust-forming organisms is enhanced by turbulence. Deposition of organic materials removed from the upper part of the reef is facilitated by the sharp reduction in degree of water movement along the lower sides and bottom of the reef. (Auth.)

6748. Cushing, Colbert E., Jr. (Dept. of Biol., Univ. Saskatchewan, Saskatoon, Saskatchewan, Canada). 1964. PLANKTON AND WATER CHEMISTRY IN THE MONTREAL RIVER LAKE-STREAM SYSTEM, SASKATCHEWAN. Ecology, Vol. 45, No. 2, pp. 306-313.

The relations between dissolved solids, water exchange, and productivity were studied in a lake-stream system. Detached epilithic algae composed the plankton of the upper stream, but all other stations displayed a lentic plankton. Turbidity and unsuitable substrate prevented the development of sessile algae on the bottom of the slow-flowing river sections (lakes), but the macrophytes provided a surface for the development of these communities. The concentrations of total dissolved solids and those ions essential for photosynthesis and algal nutrition decreased downstream coincident, in general, with a downstream increase of phyto- and zooplankton numbers. The different rates of the decrease of these nutrients in the upper stream and lake-stream section are probably related to the greater populations of autotrophic biota in the latter section. Assuming that nutrients are being added to the system throughout its course, then the downstream decrease indicates that the increasingly large autotrophic populations are assimilating these nutrients at a rate greater than they are being added. Thus, the deciding factor regulating the accumulation or removal of dissolved nutrients in a lake-stream system appears to be the degree of autotrophic enrichment of the system. (Auth.)

6749. Hubbs, Clark (Dept. of Zool., Univ. Texas, Austin). 1964. EFFECTS OF THERMAL FLUCTUATIONS ON THE RELATIVE SURVIVAL OF GREENTHROAT DARTER YOUNG FROM STENOTHERMAL AND EURYTHERMAL WATERS. Ecology, Vol. 45, No. 2, pp. 376-379.

Adaptation of a stenothermal spring population of greenthroat darter young to thermal fluctuations is compared experimentally with that of eurythermal stream populations of the same species. A constant temperature locality was chosen for the stenothermal population collection site. Stocks of the stream population were obtained from 3 nearby areas in the same stream system. Experiments were carried out on zygotes derived from gametes removed from wild-caught parents and the resulting developmental stages through late larvae. Results showed increased resistance to thermal shock with increased temperature fluctuations. (Auth.)

6750. Fish, G. R. (Marine Dept., Rotorua, New Zealand). 1963. OBSERVATIONS ON EXCESSIVE WEED GROWTH IN TWO LAKES IN NEW ZEALAND. New Zealand Journal of Botany, Vol. 1, No. 4, pp. 410-418.

Weed growth during recent years in Rotorua and Rotoiti Lakes has become sufficiently abundant to threaten normal use of lacustrine facilities, such as angling, boating, etc. Data referring to the ecology of the weed are presented from the results of a survey made during 1961. An arsenical herbicide failed to control the weed growth, possibly because of the low temperature of the lake water, or of an acquired tolerance to the poison since high arsenic levels were found already to exist in the plants and bottom deposits of the lakes. The dangers to the trout fishery of further eutrophication in these lakes are discussed. (Auth.)

6751. Cross, John E. (Ohio Div. of Wildlife, Columbus). 1964. WALLEYE DISTRIBUTION AND MOVEMENTS IN BERLIN RESERVOIR, OHIO. Ohio Dept. Natural Resources, Publ. W-337, 9 pp.

A total of 4,963 walleye pike were tagged in Berlin Reservoir at five spring and three fall netting locations during 1959 through 1963. Returns on 665 tagged fish were obtained between the spring netting period of 1959 and the fall of 1963; but only 480 were accompanied by enough data to be usable.

The data indicated that the tagged walleyes return to the same spawning areas in successive years. Movement from one spawning area to another occurred during the same spawning season, in closely associated spawning grounds. A tendency to fan out from the spawning grounds to all parts of the lake was noted following the spawning season. The preference of Area B for spawning, movement into this area by spawners tagged on other grounds, and the concentrations here during the fall, indicate the importance of this section of the reservoir to the walleye program at Berlin Reservoir. The loss of walleyes over the wasteweir provided angling for this species in downstream waters below Berlin Reservoir. (Auth.)

6752. Walker, John D. (Ohio Div. of Wildlife, Wildlife District Six, Xenia, Ohio). 1963. TROUT MOVEMENT AND HARVEST IN THE MAD RIVER, OHIO. Ohio Dept. of Natural Resources, Publ. W-65, 3 pp.

On November 12 and 13, 1959, the Division of Wildlife stocked 118 tagged rainbow trout in Macochee Creek and 187 at three locations in the Mad River. Additional stocking of 187 were made in Macochee Creek on March 29 and 30, 1960, and 625 at five sites in the Mad River on the same dates.

No publicity followed these releases and no intensive program of creel census was initiated to evaluate the harvest. The data on harvest was obtained by voluntary returns, and reports from local game protectors in their routine checks of fishermen on the stream. Much of the data was incomplete and could not be used in all compilations.

Three hundred and seven or a total of 29.3 percent were returned from anglers. This is a good return, but most dump-catch programs produce a higher rate of return. Anglers took 68.8 percent of the fall-stocked trout in 150 days after stocking, as compared to 90 percent of the spring-stocked fish in the same period of time.

The data indicates that 79 percent of the spring- and 62.8 percent of the fall-stocked fish were taken in locations other than those in which they were planted. Approximately 49 percent moved downstream, 19 percent upstream and 32 percent were taken near where they were planted. The spring-stocked fish in the Mad River showed less tendency to move than those stocked in the fall. The reverse was found in those planted in Macochee Creek.

All the trout were taken in that part of the stream system which is considered as the best waters. (Auth.)

6753. Baker, Carl (Ohio Div. of Wildlife, Oxbow Field Center, Defiance). 1963. FISH HARVEST BY WIRE NETS IN A STREAM IMPOUNDMENT. Ohio Dept. of Natural Resources, Publ. W-323, 14 pp.

The experimental use of wire traps was to evaluate this method of harvest on game, pan, and rough species of fish. The test area selected was a fifteen mile impounded section of a large sluggish stream located in northwestern Ohio. This stream has heavy deposits of silt and is known to have large populations of rough fish.

Four different types of wire traps were designed of poultry netting from a basic pattern of a wire trap two feet in diameter and four feet long. Variance from basic pattern included traps of single funnels, double funnels, one- and two-inch mesh wire. Each type of wire trap was fished the first week of each month of sixteen intermittent months from April 1956 through October 1957 at twenty selected trap locations having a variety of stream habitat conditions.

All types of wire traps fished a total of 24,552 hours, taking 3,466 fish for a catch of 0.14 fish per trap hour. There was no significant difference in the catch of the single and double funnel traps. However, the one-inch mesh traps captured 81.5% of all the fish, with the two-inch mesh traps capturing the remaining 18.5%. The one-inch mesh traps took principally game or pan fish, 72%, as compared to 28% rough fish. The two-inch mesh traps were selective in taking rough fish 92%, as compared to only 8% game or pan fish.

The majority of the fish were captured during the spring months of April, May, and June, with the trap locations having greater depths, gravel or hard clay substratum, and swift to moderate currents yielding more fish per trap hour. The use of various types of baits indicated no apparent increase in the numbers of variety of species of fish captured. An increase in the water transparency caused a decrease in the catch per hour of the wire traps. Test nets yielded 17.59 fish per hour and anglers caught 1.59 fish per hour during the wire trap project throughout the same stream test area as compared to 0.14 fish per hour taken in wire traps.

The use of inch mesh traps in this area would not harm the game and panfish populations of the stream as they would be selective in increasing the harvest of rough species that are present. While the wire trap catch per hour was lower than the angler catch per hour, the amount of effort expended by the individual operating the traps would be much less than the time the trap fished, thus allowing him to capture increased quantities of fish per unit of effort. (Auth.)

6754. Keller, Myrl (Ohio Div. of Wildlife, Columbus). 1962. LAKE ERIE SPORT FISHING SURVEY. Ohio Dept. of Natural Resources, Publ. W-316, 19 pp.

Angling intensity and success was investigated in Ohio waters of Lake Erie during summer and winter periods from 1958 through 1960. A partial sampling plan was used, with the survey area divided into sub-areas.

Estimates of total boat anglers and man-hours fished remained fairly constant throughout the

survey periods, with total fish harvested increasing from 2.6 million in 1958 to 3 million in 1960. The ice angling harvest was 175,000 fish in the 1958-59 season, increasing to 389,000 in 1959-60. Total fish per man-hour of effort were higher during summer angling than that computed during ice angling. The summer angling fish per man-hour was greatest during the months of September, October, and November.

The geographical location of the sub-areas and seasonal availability of different fish determined the species composition of the catch. Yellow perch, Perca flavescens, were most abundant in the catches, followed by sheepshead, Aplodinotus grunniens, white bass, Roccus chrysops, smallmouth bass, Micropterus dolomieui, channel catfish, Ictalurus punctatus, and walleyes, Stizostedion vitreum vitreum (Mitchill), in that order during the boat angling season.

The ice angling harvest was made up of yellow perch, American smelt, Osmerus mordax, white bass, and walleyes in this order of abundance to the catch.

The data suggest that weather and sea conditions are probably the most influencing factors on angling intensity. During the summer angling period in the Bass Island area, weekday boat counts ranged from 0 to over 600 in a single day. Holidays and weekend days boat counts in this same area ranged from less than 100 to over 2,000 in a single day. Weekday angling activity was intensified during June, July, and August; whereas, the greatest holiday and weekend days activity occurred during August, September, and October. In 1959 and 1960, the average hours fished per fishing day (5.25) were identical.

The study suggests that the total sport fishing harvest of yellow perch in certain years may exceed that harvested by the Ohio Commercial fishing industry. In 1960, the Ohio Commercial harvest of yellow perch, during the months of June, July, August, and September, was 1,290,000 pounds. The 1960 boat angler harvest for the same period of time was estimated to be 1,300,000 pounds or 10,000 pounds more than the commercial harvest. (Auth.)

6755. Anonymous (U. S. Dept. of Hlth. Edu., and Wlf., Div. Water Supply & Pollution Cont., Basic Data Br., Washington, D. C.). 1963. POLLUTION-CAUSED FISH KILLS IN 1963. Public Health Serv. Publ. No. 847, 26 pp.

The fourth annual fish kill report of the Public Health Service's Division of Water Supply and Pollution Control shows that pollutants arising from industrial operations led all categories both as to number of kills and number of fish. Agricultural operations, chiefly pesticides, were second in number. Municipal sewage, in dubious third place, was suspect, but could not be positively pinpointed, in the year's largest kill of 2 million fish.

A total of 6,816,530 fish were reported killed by water pollution in the United States in the year ending December 31, 1963, as compared to 6,200,000 the previous year.

6756. Burdick, G. E., E. J. Harris, H. J. Dean, T. M. Walker, Jack Skea, and David Colby (New York State Cons. Dept., Albany). 1964. THE ACCUMULATION OF DDT IN LAKE TROUT AND THE EFFECT ON REPRODUCTION. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 127-136.

Hatchery losses of lake trout fry from areas of high DDT use led to a 4-year study of the accumulation of the chemical in fish flesh and eggs from a number of waters in New York. Graphs are presented to indicate the range of DDT content of ether-extracted oils from spawning female lake trout and a comparison of the amount in the oil of the adult with that in the eggs. No constant relationship was found. A procedure is described to relate the mass of the fry at the time of development of the syndrome associated with the mortality to the DDT in the ether-extracted oil of the eggs. Graphical plotting of the concentration in the mass of the fry shows a relatively close relationship between the ppm of DDT and the mortality. (Authors)

6757. Horak, Donald L., and Howard A. Tanner (Colorado Game, Fish and Parks Dept., Fish. Res. Center, Fort Collins). 1964. THE USE OF VERTICAL GILL NETS IN STUDYING FISH DEPTH DISTRIBUTION, HORSETOOTH RESERVOIR, COLORADO. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 137-145.

The depth distribution of four fishes was studied using specially constructed vertical gill nets on Horsetooth Reservoir, Colorado (1960-61). Of several environmental factors measured, water temperature was the one factor that exerted a measurable effect. Depth of capture increased for the rainbow trout, kokanee salmon, and white sucker as each summer progressed and in general followed the isotherms. The distribution of yellow perch was unaffected by temperature changes. Kokanee salmon were most abundant in waters of 51-55° F while the rainbow trout and white suckers were most numerous in 66-70° F waters. (Authors)

6758. Clugston, James P. (Game and Fresh Water Comm., Leesburg, Florida). 1964. GROWTH OF THE FLORIDA LARGEMOUTH BASS, MICROPTERUS SALMOIDES FLORIDANUS (LESUEUR), AND THE NORTHERN LARGEMOUTH BASS, M. S. SALMOIDES (LACÉPÈDE), IN SUBTROPICAL FLORIDA. Transactions of the American Fisheries Society, Vol. 92, No. 3, pp. 146-154.

Three ponds near Fort Lauderdale, Florida, were stocked with Florida largemouth bass fingerlings in April 1960. In July 1960, two ponds were stocked with northern largemouth bass fingerlings imported from Iowa. Samples of the bass were collected every month from each pond. The objectives of the study were: to investigate the seasonal pattern of growth of the largemouth bass, to determine possible differences in growth rates related only to the advent of sexual maturity, and to determine whether or not these subspecies would show

differences in growth rate when grown under similar conditions in Florida.

Temperature conditions in South Florida appear to be suitable for growth of the largemouth bass the year around. Both subspecies grew very fast in the study ponds. The northern form grew more rapidly than the southern bass during the early life history, but temperature differences could account for this difference in growth. The northern bass did not become mature during the experiment and the southern form matured at about 9 months of age. The length-weight relationship of the bass populations differed although there is no evidence that these are related to the subspecies. All of the bass populations exhibited high condition factors for most of the year and, in general, the populations that consistently exhibited the highest condition factors grew faster than those with lower condition factors. (Auth.)

6759. Smith, Stanford H. (U. S. Bur. Comm. Fish. Biol. Lab., Ann Arbor, Michigan). 1964. STATUS OF THE DEEPWATER CISCO POPULATION OF LAKE MICHIGAN. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 155-163.

The species and size composition and the abundance of the cisco (Leucichthys spp.) population of Lake Michigan have undergone drastic changes since the sea lamprey became established in the 1940's. The changes were measured by the catches of gill nets of identical specifications fished at the same seasons, depths, and locations in 1930-32, 1954-55, and 1960-61. The two largest ciscoes (johannae and nigripinnis), exploited heavily in a highly selective fishery from the midnineteenth century to the early 1900's, were only sparsely represented in the catch in the 1930's and were absent from catches of the comparison surveys in 1954-55 and 1960-61. The species of intermediate size (alpenae, artedii, kiyi, reighardi, and zenithicus) constituted about two-thirds of the cisco stocks of the deepwater zone in the 1930's but declined to 23.9 and 6.4 percent in the 1950's and 1960's, respectively. Major causes of change were the increased fishing pressure and sea lamprey predation that accompanied the disappearance of the lake trout. The small, slow-growing cisco (hoyi)--the primary food of lake trout--which was not fished intensively, and was too small to suffer greatly from sea lamprey predation, increased from 31.0 percent of the catch in the 1930's to 76.1 percent in the 1950's and 93.6 percent in the 1960's. Consequences of the extreme imbalance of the cisco population have been a reduction in mean size of all species, extension of the range of the very abundant hoyi (formerly most abundant in moderately shallow areas) to almost all depths and sections of the lake, and possibly introgressive hybridization among the various species. The primary change in the fishery has been a shift from gill nets to more extensive use of trawls which can take the now abundant smaller fish. (Auth.)

6760. Hooper, F. F., and R. C. Ball (Inst. for Fish. Res., Michigan Dept. of Cons., Univ. Mus. Annex Bldg., Ann Arbor). 1964. RESPONSES OF A MARL LAKE TO FERTILIZATION. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 164-173.

A shallow marl lake was fertilized during three consecutive years with inorganic fertilizer. Application was made in midsummer and evaluation of its effect was made by comparing data gathered in a pretreatment and a posttreatment period each year. Fertilization brought about an immediate increase in suspended solids and a decrease in transparency. These changes appeared to be caused by a coalescence of suspended marl rather than by chemical precipitation or by an increase in phytoplankton. A large fraction of the added phosphorus disappeared from the water along with the suspended marl. When solids were separated from the water with a centrifuge, we were unable to detect an increase in the organic fraction of the solids after fertilization. However, during the third year of the study a small increase was noted when a Millipore filter was employed. Inorganic nitrogen and phosphorus remained in the water for a very short period; however, an organic phosphorus fraction persisted 25 days or more.

In 1954 and 1955 we were unable to detect living phytoplankton cells in solids separated from the water either before or after fertilization when a Foerst centrifuge was used to separate suspended matter. In 1956 a sparse flora of nannoplankton was concentrated from the water using a Millipore filter, and the number of nannoplankton genera increased following fertilization. This response was weak and did not affect the transparency of the lake water. Fertilization brought about a well-marked increase in the production of periphyton algae in all three years. The data suggest that benthic algae are more effective than planktonic algae in utilizing nutrients added to marl lakes. (Authors)

6761. Mount, Donald I. (U. S. Dept. of Hlth., Edu., and Wlf., Robt. A. Taft Sanit. Engng. Center, Cincinnati, Ohio). 1964. AN AUTOPSY TECHNIQUE FOR ZINC-CAUSED FISH MORTALITY. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 174-182.

An autopsy method for acute zinc toxicity in fish has been developed. The method is based on the accumulation of zinc in the gills that precedes death due to acute exposure to zinc in the water. Thirty- to 90-day exposures to sublethal concentrations of zinc in water indicated that the opercular bone accumulates zinc at approximately the same rate as the gill tissue (including rakers and arch) but the operculum does not accumulate zinc as the gill does in acutely toxic exposures. By using the ratio of zinc in the gill to zinc in the bone (gill/bone ratio), a reasonably constant value is obtained for nonlethal exposures and for fish collected in the field. This value increases up to a hundredfold in acute exposures.

Experimental exposures on five species of fish were made and the fish autopsied. Field samples of more than 1,000 fish of 22 species were analyzed

and the data given. There is almost no overlap between the gill/bone ratios of normal fish from the field and experimental fish killed by zinc. One species, carp (Cyprinus carpio), could not be autopsied by examination of a few specimens.

This method seems to be specific for zinc mortality, is not affected by small amounts of other toxicants or by disease, can be performed on partially decomposed fish, and does not necessitate the immediate removal of fish from the contaminated water. (Auth.)

6762. McFadden, James T., James R. Ryckman, and Gerald P. Cooper (Inst. for Fish. Res., Michigan Dept. of Cons., Ann Arbor). 1964. A SURVEY OF SOME OPINIONS OF MICHIGAN SPORT FISHERMEN. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 183-193.

A two-stage sampling design with fishing license dealers as primary sampling units within which licensed fishermen were subsampled was used to obtain a sample of opinions on certain fish management practices from resident and nonresident anglers in Michigan.

Fishing license dealers were divided into 96 groups (strata), each consisting of dealers in a restricted geographical area whose combined 1961 license sales totaled approximately 9,580. Two dealers were selected from each stratum with probability proportional to estimated size, i.e., the more licenses a dealer sold, the greater the chance of his being included in the sample. Approximately six fishermen per dealer were mailed postcard questionnaires. The sample thus included 192 out of some 4,116 fishing license dealers and, allowing for nonrespondents, 927 fishermen out of a total of 926,470. All licensed fishermen were equally likely to be included in the sample. Three mailings plus a fourth contact attempt by mail, telephone, or personal contact yielded responses from 85.7 percent of the 1,082 fishermen to whom questionnaires were sent. Respondents were distributed among the three Conservation Regions in about the same proportion as license sales. There was no substantial difference in opinions among the three Conservation Regions of the state. Among the opinions expressed by fishermen which are summarized and discussed in this paper, the following were considered especially pertinent to management programs. Few people think that too great a proportion of the Conservation Department's budget is spent on trout stocking. Among nontrout fishermen, who help to finance the trout stocking program through license fees, 52 percent have no opinion about the current expenditure. Among trout fishermen 42 percent desire to have more spent on trout stocking, while 58 percent are satisfied with the present level of expenditure, think too much is spent, have no opinion, or gave no answer to this question. Fifty-two percent of trout fishermen preferred to have trout stocked in streams, and 36 percent preferred stocking in lakes. The management activity most frequently selected as needing to be increased to meet future fishing needs was "lake and stream improvement," followed by "research on improvement of fishing," then "warm-water fish stocking," and "buying public fishing sites" mentioned with equal frequency in third and fourth places, and finally "law enforcement" and "trout stocking." (Authors)

6763. Hunt, Robert L., and Oscar M. Brynildson (Wisconsin Cons. Dept., Madison). 1964. A FIVE-YEAR STUDY OF A HEADWATERS TROUT REFUGE. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 194-197.

As a means of providing better trout fishing, the experimental headwaters refuge on Lawrence Creek was a failure. When it was open to fishing, it bolstered the catch by 21 percent. As a refuge it increased the catch by only 1 percent. While the refuge did function as a nursery area, its net contribution of fry and fingerlings was 5 percent or less of the total number of such trout present in the fishing waters. Furthermore, these young trout required no regulatory protection from angling. Because of their small size they were practically invulnerable to most angling methods. Since headwaters refuge areas containing a fishable population of adult brook trout are likely to result in a waste of trout rather than a major improvement in the fishery, their use in the management of wild brook trout is not recommended. (Authors)

6764. Clemmer, Glenn H., and Frank J. Schwartz (Chesapeake Biol. Lab., Solomons, Maryland). 1964. AGE, GROWTH, AND WEIGHT RELATIONSHIPS OF THE STRIPED KILLIFISH, FUNDULUS MAJALIS, NEAR SOLOMONS, MARYLAND. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 197-198.

Males beyond age I, 64.8 mm total length, grew 4.4-21.0 mm each year, whereas females beyond age I (60.7 mm) grew 8.0-28.3 mm each year. Males beyond age I were consistently smaller than females. Males lived only 6 years while females lived 7. The sex ratio varied greatly from season to season and year to year but seemed to favor the female. (Authors)

6765. Courtright, Robert C. (Dept. of Fish and Game Mgmt., Oregon State Univ., Corvallis). 1964. A METHOD FOR MAKING FISH SCALE IMPRESSIONS IN THE FIELD OR LABORATORY. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 200-201.

A process employing vinyl plastisol for making fish scale impressions is described.

6766. Priegel, Gordon R. (Wisconsin Cons. Dept., Oshkosh). 1964. EARLY SCALE DEVELOPMENT IN THE WALLEYE. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 199-200.

The data on the relation of body length to scale development were obtained from 220 specimens. Scales first appeared on several of the 24-millimeter class, and all fish in the 29-millimeter class possessed well-defined scale patterns.

Scales first appeared on the caudal peduncle

near the lateral line and the scale pattern increased in size by accelerated growth anteriorly along the lateral line. By the time the fish had reached a length of 30-37 millimeters, the scale pattern progressed more ventrally than dorsally. Fish in the 39-millimeter class possessed scales anteriorly to the gill opening. Ventral to the lateral line the posterior portion of the body was completely covered. Dorsal to the lateral line, scale formation proceeded at a less rapid rate. At 40 millimeters, the area of most rapid increase of scale development was dorsal to the lateral line, leaving only the nape area naked. The fish was completely scaled at 45 millimeters. (Auth.)

6767. Power, G. (Dept. of Biol., Univ. of Waterloo, Waterloo, Ontario, Canada). 1964. A TECHNIQUE FOR PREPARING SCALE SMEARS. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 201-202.

Particulars are presented on the preparation of fish scale smears employing cellulose acetate slides 0.001 inch in thickness.

6768. Minckley, W. L. (Dept. of Zool., Arizona State Univ., Tempe), Richard H. Goodyear, and James E. Craddock. 1964. INCIDENCE OF ABERRANT SCALATION IN CATOSTOMID FISHES FROM DOE RUN, MEADE COUNTY, KENTUCKY. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 202-203.

Observations were made on the proportion of the sample of each species that exhibited deformation in scalation, on the degree of aberrancy of scale patterns, and on the position of the deformation on the body. The following percentages of each sample had some aberration: Hypentelium nigricans (LeSueur), 15.4 (n = 130); Minytrema melanops (Rafinesque), 15.1 (n = 139); Moxostoma anisurum (Rafinesque), 50.0 (n = 4); M. breviceps (Cope), 51.8 (n = 56); M. duquesnei (LeSueur), (n = 24); M. erythrurum (Rafinesque), 22.3 (n = 103); and Catostomus commersoni (Lacépède), 11.5 (n = 78). Thirteen specimens of Ictiobus bubalus (Rafinesque) and 16 Carpiodes carpio (Rafinesque) were normal. The degree of aberrancy was greatest in M. anisurum, and both individuals having whorls of scales over their entire bodies. Moxostoma breviceps also exhibited a high degree of abnormality. Aberrant scalation was usually localized on a given fish, generally in the region of the dorsal fin, but varied greatly among the species studied. The reasons for the anomalies are obscure.

6769. Talbot, Gerald B. (U. S. Bur. Spt. Fish. & Wildl., Tiburon Marine Lab., Tiburon, California). 1964. DRIFT BOTTLE MODIFICATIONS FOR AIR DROPS. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 203-204.

Experiments were carried out to test the practicability of dropping drift bottles from aircraft to determine ocean currents. It was concluded that drift bottles should be corked and capped when they are released from flying aircraft, and that releases at elevations below 2,000 feet are desirable to prevent bottle breakage.

6770. Manz, Jerry V. (Ohio Div. of Wildlife, Sandusky). 1964. A PUMPING DEVICE USED TO COLLECT WALLEYE EGGS FROM OFFSHORE SPAWNING AREAS IN WESTERN LAKE ERIE. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 204-206.

The pumping device is a 3-inch gas-operated centrifugal water pump with a 28,000 gallon per hour capacity. The pump draws water into a 55-gallon steel tank with a lid fitted with a heavy rubber gasket and secured with hinged bolts and wing nuts. A copper screen filter (16 meshes to the inch) with a detachable stainless-steel bucket is placed in the tank so the pump draws water through it. A vacuum gauge and thermometer are also attached to the drum. A 3-inch suction hose is attached to a check valve on the tank and water is drawn into the tank from an intake mounted on a sled that is drawn along the bottom. A secondary intake line fitted with a pressure control valve and drum refill line is located between the pump outlet and the drum. It works exceptionally well on gravel, boulder, or shelf rock, but mud, silt, or sand tend to clog the screen filter. This device also appears to have value for sampling the bottom fauna associated with walleye spawning areas.

6771. Howell, John H., and Paul M. Thomas (U. S. Bur. Comm. Fish., Millersburg, Michigan). 1964. ANESTHETIC EFFECT OF 4-STYRYLPYRIDINE ON LAMPREY AND FISH. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 206-208.

Experiments were conducted to assess the possible value of 4-SP as an anesthetic on 3 species of lamprey and 5 species of fish. The time to anesthesia at 20 ppm was nearly the same for the white sucker, pumpkinseed, yellow perch, fathead minnow, rainbow trout, silver lamprey and American brook lamprey. Adult sea lamprey and the three groups of larval lamprey were more resistant. The relation of concentration to recovery time differed among the test animals. The times to anesthetization and for recovery with 4-SP are similar to those determined at considerably higher concentrations of other anesthetics.

6772. Whitworth, W. R. (U. S. Fish & Wildl. Serv., Southeastern Fish Control Lab., Warm Springs, Georgia), and W. H. Irwin. 1964. OXYGEN REQUIREMENTS OF FISHES IN RELATION TO EXERCISE. Transactions of the American Fisheries Society, Vol. 93, No. 2, pp. 209-212.

The primary purpose of this study was to measure the ability of nine species of fishes to swim for 6 hours in flowing waters of low oxygen content. An apparatus to control the rate of water flow and concentration of dissolved oxygen is described. Most specimens initially reacted to water flow by

swimming rapidly from one screen to the other, making one or two trips, then all oriented to meet the current. Data obtained from specimens tested in the swimming chamber showed that oxygen concentrations of about 2 ppm were required to maintain most fishes when water temperatures were in the 70° to 80° F range, whereas most fishes not stimulated to activity tolerated oxygen levels of about 1 ppm.

6773. Segaar, J., and R. Nieuwenhuis (Netherlands Ctr. Inst. Brain Res., Amsterdam). 1963. NEW ETHO-PHYSIOLOGICAL EXPERIMENTS WITH MALE GASTEROSTEUS ACULCATUS, WITH ANATOMICAL COMMENT. Animal Behaviour 11(2/3): 331-344; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9467. 1964.

On fixed days in the controlled reproductive cycle, quantitative methods showed a pattern of aggression, sexual and parental tendencies in normal sticklebacks. After frontal or bilateral lesions in the telencephalon on the one hand and after larger bimediocaudal lesions on the other, the normal pattern altered in two opposite directions. These alterations suggested that the pattern in normal animals represents a relative balance of the three tendencies involved and that the patterns in operated animals represent modifications of this dynamic equilibrium. After various small bimediocaudal or bimediocentral coagulations, the investigations penetrated into this balance-as-a-whole, isolating in particular the inhibition and the facilitation of parental care, whereas aggression and sex remained as they were in unoperated animals. Histological examination showed that by these coagulations specific centers had been localized. (Authors)

6774. Aslanova, N. E. 1958. FISH BEHAVIOR IN THE ZONE OF ACTION OF FISHING GEAR. (IZUCHENIE POVEDENIYA RYB V ZONE DEISTVIYA ORUDII LOVA.) Tr. Vses. Nauchn.-Issled. Inst. Morskogo Rybnogo Khoz. i Okeanogr. 36. 33-51; Referat. Zhur., Biol., 1959, No. 49335; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9578. 1964.

Hydroacoustic and visual observations were made of the behavior of a series of Black and Caspian Sea fish in fishing gear (pound nets, purse seines, midwater trawls). The reaction of various fish to the twine of which the net is made was elucidated, as well as the relation of this reaction to the size of the openings of the net and its color, on the illumination and transparency of the water, on the biological condition, stage of development, and density of fish in the school. The behavior of fish in pound nets at various speeds of water flow, and the influence of noise stimuli on fish behavior were also investigated. Experimental investigations on the behavior of Black Sea fish (8 species) and Caspian Sea fish (4 species) at various flow speeds (orientation with relation to the flow, resistance to flow in various stages of the life cycle) were carried out. On the basis of the investigations and a survey of publications, practical recommendations are made on the best use of traditional fishing gears (pound nets and purse seines) in fishing various fish and introduction of new devices (midwater trawl, fish pump RB-150). A survey of publications on the elaboration of conditioned reflexes in fish is given. Reflex reactions of commercial fish to various fishing instruments are still unknown. Bibliography with 53 references. (Courtesy NSF (PL 83-480) 1963)

6775. Burmakin, E. V. 1962. A CHEMICAL METHOD FOR THE CONTROL OF UNDESIRABLE FISH IN UNDRAINABLE PONDS AND SMALL LAKES. (KHIMICHESKII METOD BOR'BY S NEZHELATEL'NYMI RYBAMI V NESPUSKNYKH PRUDAKH I MALYKH OZERAKH.) Tr. Sovesch. Ikhtiol. Komis. Akad. Nauk SSSR 14. 84-87; Referat. Zhur., Biol., 1963, No. 10I61; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9584. 1964.

In 1959 experiments were conducted on the extermination of fish (perch) in two lakes of the Pskov region. The lakes had an area of up to 6 ha and a depth of up to 8 m. Treatment of the lakes with polychlorpinene at a concentration of 0.25 mg/l led to complete extermination of perch. Maximum permissible concentration of polychlorpinene in water bodies can be 0.5 mg/l. Lakes treated with polychlorpinene remain toxic for about a year. Water masses cleared of fish in this manner can be used as fish hatcheries.

6776. Doi, Takayuki. 1962. APPROACH FROM POPULATION DYNAMICS TO RATIO OF SALMON FALLING OFF GILL NETS. Bull. Tokai Reg. Fish. Res. Lab. 34. 13-18; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9588. 1964.

In North Pacific salmon fisheries a number of fish caught by coastal set nets show injuries attributable to gill nets or longlines operated at sea. Apparently, they have fallen off gears used in offshore fisheries. The writer presents a method to estimate the coefficient of falling-out from experimental operations of gill nets in the open sea, and one for fish in ponds. Examples of coho (Oncorhynchus kisutch) and sockeye (O. nerka) are shown. (Auth.)

6777. Gribanov, L. V. 1962. CONDITION OF FISH FAUNA IN RESERVOIRS OF THE HEIGHT OF LAND ALONG THE MOSCOW CANAL. (SOSTOYANIE IKHTIOFAUNY VODOKHRANILISHCH VODORAZDEL'NOGO B' EFA KANALA IM. MOSKVY.) Tr. Vserossiisk. Nauchn.-Issled. Inst. Prudovogo Rybn. Khoz. 11: 89-103; Referat. Zhur., Biol., 1963, No. 10I74; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9601. 1964.

Composition of the fish fauna, development of the fishing and condition of the fish stocks at the present time in the Klyazminsk, Pyalovsk, Pestovsk, and Ikshinsk Reservoirs. The fishery is based on the catch of young age groups, in particular on immature, large run-of-the-mill species of fish (taken

in the nets usually used). It is proposed that the conditions for spawning be improved by the creation of artificial spawning grounds, by stocking the reservoirs with the young of valuable fish (pike-perch, bream, and others), by regulation of the abundance of less valuable fish through the propagation of bream and pike-perch, and by the rationalization of the fishery, which should be based on the autumn-winter catch of fish from 3 to 4 years of age. Bibliography includes 29 titles.

6778. Cherkin, Arthur, and J. F. Catchpool (Gates and Crellin Laboratories of Chemistry, California Inst. of Technology, Pasadena). 1964. TEMPERATURE DEPENDENCE OF ANESTHESIA IN GOLDFISH. Science, Vol. 144, No. 3625, pp. 1460-1461.

The anesthetizing concentrations in water of diethyl ether, chloroform, halothane ($CF^3CClBrH$), and methaxyflurane ($CHCl^2CF^2OCH^3$) have been determined for temperature-acclimated goldfish (Carassius auratus) at 5° to 30° C. At 20° C, the concentrations that anesthetize 50 percent of the fish are 2160, 167, 76.4, and 57.0 mg/liter, respectively; the corresponding partial pressures are 13.0, 3.36, 4.12, and 0.67 mm-Hg. The anesthetizing partial pressures increase with body temperature, with enthalpies of 8.6, 13.2, 12.5, and 12.3 kcal/mole, respectively. (Authors)

6779. Johnson, Lionel (Arctic Biol. Sta., Fish. Res. Bd. of Canada, Montreal, Quebec, Canada). 1964. TEMPERATURE REGIME OF DEEP LAKES. Science, Vol. 144, No. 3624, pp. 1336-1337.

New data concerning the temperature of maximum density of fresh water under pressure have been obtained in Great Bear Lake, in the Northwest Territories of Canada. Previous theoretical determinations are discussed; Strøm's empirically determined figures are in agreement with these data. (Auth.)

6780. Thomas, J. D. (Dept. of Zool., Univ. of Ghana, Legon, Accra, Ghana). 1963. STUDIES ON THE GROWTH OF TROUT, SALMO TRUTTA, FROM FOUR CONTRASTING HABITATS. Proceedings of the Zoological Society of London, Vol. 142, Part 3, pp. 459-509.

An ecological investigation was undertaken at four contrasting stations on three river systems in West Wales, namely the Teify, the Rheidol, and the Pysgotwr, with a view to evaluating the effect of ecological factors, particularly the helminth parasites, on the growth of the trout. When compared with the larger, faster-growing trout from the two stations (A and B) on the Teify, the slow-growing trout from the other two stations (C and D), located in each of the more acid rivers, were characterized by a lower specific growth rate, a more restricted growing season, a lower condition factor, less fat on the pyloric caeca, and earlier maturation of the gonads. The diet of the smaller, slow-growing trout contained a smaller proportion of large, readily accessible food and seemed to be more adversely influenced by the effect of floods and the onset of winter than was the case with trout at the other stations. There was no evidence that poor growth of trout in the more acid streams was due to the effect of helminth parasites. Of the thirteen species of helminths encountered in the trout at Stations A and B only three occurred commonly at Stations C and D and the only demonstrably pathogenic helminths, namely the acanthocephalan Neoechinorhynchus rutili and the plerocercoid larva of Diphyllobothrium were conspicuously absent. The growth of the trout appeared to be a function of several components of the ecosystem. Favorable productivity indices include a pH of approximately 7 or more, a high ionic and calcium content, a large area of depositing substratum, a low susceptibility to sudden flooding, a favorable temperature regime, a rich growth of algae and phanerogams, a wide variety and high density of animals including those of a large size and high accessibility and, finally, a rich fauna of helminth parasites, particularly nematoda and acanthocephala. (Auth.)

6781. Mackiewicz, J. S. (Univ. of Oklahoma Biol. Sta., Lake Texoma). 1964. VARIATIONS AND HOST-PARASITE RELATIONSHIPS OF CARYOPHYLLAEIDS (CESTOIDEA) FROM FISH OF LAKE TEXOMA, MARSHALL COUNTY, OKLAHOMA. The Journal of Parasitology, Vol. 50, No. 3, Sect. 2, Abstract No. 46.

Examination of Ictiobus bubalus, I. cyprinellus, and Carpiodes carpio (all Catostomidae) during the summers of 1963 and 1964 revealed eight caryophyllaeid species: Glaridacris confusus Hunter, Capingens singularis Hunter, Monobothrium ingens Hunter, Spartoides wardi Hunter, two undescribed species of Biacetabulum, and two unknowns. No cestodes were found in Cycleptus elongatus. Cyprinus carpio from the lake contained Khawia iowensis Calentine and Ulmer, while those from the Red River below Lake Texoma were infected with Atactolytocestus huronensis Anthony.

Variations of systematic importance included a broader range in testes number than previously reported (G. confusus), absence of postovarian vitellaria (G. confusus and Biacetabulum sp.), and undescribed scolex morphology (M. ingens).

Host-parasite relationship data concerned worm burden, seasonal variation in incidence, multiple species infections, apparent host specificity, and variations in attachment. Intergeneric host infections with the same species were uncommon.

6782. Merritt, Sheridan V., and Ivan Pratt (Dept. of Zool., Oregon State Univ., Corvallia). 1964. THE LIFE HISTORY OF NEOECHINORHYNCHUS RUTILI AND ITS DEVELOPMENT IN THE INTERMEDIATE HOST (ACANTHOCEPHALA: NEOECHINORHYNCHIDAE). The Journal of Parasitology, Vol. 50, No. 3, pp. 394-400.

The life history of Neoechinorhynchus rutili (Mueller, 1780) was demonstrated experimentally. Shelled embryos are released by the adult worm

into the lumen of the digestive tract of fresh-water fishes and subsequently pass out with the feces. These "eggs" are ingested by ostracods (Cypria turneri). Within the intestine of the ostracod, the acanthor hatches, penetrates the wall of the intestine, and in 6 to 12 days is found free in the hemocoel where it metamorphoses through the acanthella to the juvenile stage in 48 to 57 days. This stage is infective to the fish. The development in the ostracod has been followed and comparisons have been made with the other two species of the genus which have been studied. (Authors)

6783. Hartman, Wilbur L., Theodore R. Merrell, Jr., and Richard Painter (U. S. Bur. Comm. Fish., Biol. Lab., Auke Bay, Alaska). 1964. MASS SPAWNING BEHAVIOR OF SOCKEYE SALMON IN BROOKS RIVER, ALASKA. Copeia, 1964, No. 2, pp. 362-368.

The spawning behavior of sockeye salmon in Brooks River, Alaska, was studied in 1957 and 1958. In both years, 3 successive waves of spawners occupied the gravels. Males spent about 5 days on the redd sites and females about 9 days. Both sexes dug redds, but females were considerably more vigorous and effective. Males defended spawning territories vigorously, but almost entirely against other males. Females defended territories against both males and females. When the male of a spawning pair disappeared, the female defended the redd against fish of either sex. Defense of the redd has obvious survival value if successive spawning reduces overall egg survival as a result of excavation of previously deposited eggs. Differences in the life spans of males and females may cause erroneous estimates of sex ratios if counts are made of only the live or the dead fish during the spawning period. (Authors)

6784. Berry, Frederick H. (U. S. Bur. Comm. Fish., Biol. Lab., Brunswick, Georgia). 1964. ASPECTS OF THE DEVELOPMENT OF THE UPPER JAW BONES IN TELEOSTS. Copeia, 1964, No. 2, pp. 375-384.

The ossification and subsequent morphological development of the upper jaw bones were studied in ontogenetic series of selected species of five orders of bony fishes: Isospondyli, Iniomi, Anacanthini, Percomorphi, and Pediculati. In the Isospondyli, the maxillaries are the first bones to develop in the upper jaw; the premaxillaries develop next and remain in the anterior part of the jaw with the maxillaries occupying most of the gape; in a few exceptions the premaxillaries continue to grow posteriad during juvenile and adult stages. In most species of the Iniomi and the other more advanced orders, development of the jaw bones is initially similar to that in the Isospondyli, but subsequently, during the larval stage, the premaxillaries continue to grow posteriad under the maxillaries and force the maxillaries completely or largely out of the gape. (Auth.)

6785. Deacon, James E., Clark Hubbs, and Bernard J. Zahuranec (Scripps Inst. of Oceanogr., La Jolla, California). 1964. SOME EFFECTS OF INTRODUCED FISHES ON THE NATIVE FISH FAUNA OF SOUTHERN NEVADA. Copeia, 1964, No. 2, pp. 384-388.

A number of fishes have been introduced into the depauperate fish fauna of southern Nevada. Many of the introductions have had adverse effects on localized endemic species. Introduction of a cichlid and 5 poeciliids near Lake Mead seems to have resulted in elimination of a local race of Rhinichthys osculus; introduction of guppies at Preston endangers the resident population of Crenichthys baileyi; and introduction of goldfish at Manse Ranch threatens the remaining stock of Empetrichthys latos. Three of the introduced fishes, Cichlasoma nigrofasciatum, Lebistes reticulatus, and Mollienesia mexicana, do not seem to have been previously recorded to be established in the United States. (Authors)

6786. Clemens, Howard P., and W. Waynon Johnson (Fish. Res. Ctr., Dept. Zool., Univ. of Oklahoma, Norman). 1964. SPECIFICITY OF THE GONADAL HYDRATION FACTOR IN THE PITUITARY OF SOME FRESH-WATER FISHES. Copeia, 1964, No. 2, pp. 389-398.

Male goldfish (Carassius auratus) injected with pituitary extract responded by an increase in gonadal hydration. The magnitude of this response varied with the species of the donor and roughly approximated the phylogenetic closeness of the donor to the recipient. This relationship seemed true in general application but was not borne out by all donor groups. Closely associated taxonomic groups may exhibit rather wide divergences in the response elicited. Such variations in response might be due to the presence of inhibitory substances in the hormone extract.

This study was based on the gonadal hydration response produced by injections of pituitary material from 20 donor species representing 17 genera, 13 families, 8 orders, and 5 classes. (Authors)

6787. Joseph, Edwin B., William H. Massmann, and John J. Norcross (Virginia Inst. of Mar. Sci., Gloucester Point). 1964. THE PELAGIC EGGS AND EARLY LARVAL STAGES OF THE BLACK DRUM FROM CHESAPEAKE BAY. Copeia, 1964, No. 2, pp. 425-434.

Culture of pelagic eggs obtained in Chesapeake Bay near Cape Charles, Virginia, in May 1962 led to their identification as those of the black drum. The pelagic eggs and early larval stages of only 3 Atlantic species of the Sciaenidae have been described previously.

The black drum eggs were small, ranging in diameter from 0.816 to 1.020 mm. Oil globules, usually multiple in early stages, coalesced to a single globule prior to hatching. Embryonic development was estimated to have been completed in less than 24 hr at 20 C. Larvae, at hatching, ranged from 1.9 to 2.4 mm total length, and their yolk reserves became exhausted after the fourth day, whereupon feeding commenced.

Subsequent extensive sampling in early June failed to delimit the area of spawning because black drum apparently had ceased spawning in the lower bay and adjacent seaside areas. However, extensive collections of other sciaenid eggs were obtained. A critical examination of the eggs obtained in May and June failed to achieve a clear-cut separation of species solely on the basis of size and morphometry. It is concluded that identification can be achieved only through the use of information supplemental to data on the size and morphometry of the sciaenid eggs in question. (Authors)

6788. Phillips, Julius B. (California Dept. of Fish and Game, 722 Capitol Mall, Sacramento). 1964. LIFE HISTORY STUDIES ON TEN SPECIES OF ROCKFISH (GENUS SEBASTODES). The Resources Agency of Calif., Dept. Fish and Game, Fish Bull. 126, 70 pp.

Details regarding weight-length relationships, annual growth, size and age at maturity, spawning season, fecundity, and feeding habits are presented for 10 rockfishes: bocaccio, chilipepper, yellowtail, canary, vermilion, widow, dark-blotched, splitnose, stripetail, and shortbelly.

Ages were determined from body scales, and back-calculations were made to determine the growth attained when previous annuli were formed.

Calculated mean lengths agreed quite well with exponentially-fitted curves at least through ages 12 for all species, except the shortbelly rockfish whose maximum age is 10.

All but the shortbelly rockfish attain maximum ages that are calculated to be between 16 and 30 years.

Maximum weights vary from 0.6 pounds in the shortbelly rockfish to at least 15.0 pounds in the bocaccio. The largest of the rockfishes, the cow, attains a weight of at least 32 pounds.

Since all Sebastodes are ovoviviparous, the term "spawning" is synonymous with "hatching period." Spawning for nine of the species occurs during the winter, from about mid-November to mid-March. The splitnose rockfish spawns during the spring, from about February through July.

In the shortbelly rockfish, 50 percent of the 3-year-olds are mature. In the nine remaining forms, ages of 4 to 6 years had to be attained before 50 percent of the population of a given species were mature.

The number of eggs the larger females will spawn in a season varies from about 50,000 in the shortbelly rockfish to over 2 million in the bocaccio.

Stomach examinations revealed that the splitnose, stripetail, and shortbelly rockfish are essentially plankton feeders throughout life, but as adults they switch to larger planktonic organisms (macroplankton), such as euphausiids. The bocaccio feeds almost exclusively on other fishes, changing from a plankton diet before they become a year old. The remaining species feed adventitiously on macroplanktonic organisms and on small fishes.

6789. Milne, D. J. (The late) (Fish. Res. Bd. of Canada, Biol. Sta., Nanaimo, B. C., Canada). 1964. THE CHINOOK AND COHO SALMON FISHERIES OF BRITISH COLUMBIA. Fisheries Research Board of Canada, Bulletin No. 142, 46 pp.

Chinook (Oncorhynchus tshawytscha) and coho salmon (O. kisutch) in coastal waters of British Columbia are fished mainly by trollers, but also by purse seine and gill net. Ocean sport fishing for these two species has also reached considerable importance. Concern over the present status of chinook and coho stocks has prompted this study of recent trends in the fisheries up to 1960. Fishing has become highly automated and competitive. Tagging experiments have indicated that the troll fisheries exploit a mixture of chinook salmon from the Fraser River, of late-returning ("fall") fish, chiefly from the Columbia River, and of stocks from small coastal rivers in the Province. Coho salmon on the fishing grounds come from numerous small coastal streams from Alaska to California. After World War II troll fishing for chinook and coho increased along the entire Pacific coast. Commercial troll catches of chinook salmon rose to the highest levels in history, except in Alaska. Since 1953 both the Alaskan and Washington State catches declined, as did the Oregon and California catches after 1956. This is doubtless related to recent declines in the fall runs of chinook to the Columbia River since 1950, and to declines in the Sacramento River stocks since 1957. The British Columbia troll catch of chinooks dropped in 1954 and 1955, as it did in Alaska and Washington, but since then it has remained at a high level. Possibly Fraser River stocks are now being exploited more heavily than in the past. The gill net fishing effort on chinook salmon has greatly decreased in the Columbia and Sacramento Rivers, and is being severely restricted in the Fraser River. The sport fisheries along the entire coast are expanding. Troll catches of coho salmon all along the Pacific coast increased markedly after the war up to 1951. They have since declined, particularly in Southeast Alaska. Since 1951 the British Columbia troll catch of coho salmon has been the largest along the coast. Fishing for coho salmon is presently at a very high level of intensity. Fortunately, many stocks receive a measure of protection by way of regulations in effect to conserve the more abundant sockeye, pink, and chum salmon. (Auth.)

6790. Robinson, Dave, and Ray Menendez (Dept. of Natural Resources, Div. Game & Fish, Charleston, West Virginia). 1964. STREAM IMPROVEMENT ON THREE NORTHWESTERN WEST VIRGINIA WARM-WATER STREAMS. Div. Game and Fish, Federal Aid Project F-10-R, Stream & Lake Surveys, Final Report.

Three northwestern West Virginia warm-water streams were selected to test stream improvement methods. A total of 20 stream improvement structures, in the form of log, rock, and gabion dams, and deflectors, were installed in the North Fork of

Fishing Creek, and 13 in Wheeling Creek. The stream improvement structures were effective in varying degrees in creating holes and providing additional fishing water.

Over 400 cover devices in the form of four different type concrete slabs were placed in Wheeling Creek and the North Fork. One type (legs-at-one-end) proved superior. Pieces of broken concrete pavement were installed in Indian Creek.

Before and after population studies showed increases in game fish populations at cover device installation areas, in most cases. Game fish readily utilized the devices. Such cover devices were determined to be useful management tools. (Authors)

6791. Parrish, B. B. (Fish. Div., Biol. Br., Food & Agric. Org. of the United Nations, Rome, Italy). 1964. NOTES ON THE IDENTIFICATION OF SUB-POPULATIONS OF FISH BY SEROLOGICAL AND BIOCHEMICAL METHODS, THE STATUS OF TECHNIQUES AND PROBLEMS OF THEIR FUTURE APPLICATION. FAO Fish. Technical Paper No. 30, 9 pp.

Reviews concept of racial investigations, serological methods, and biochemical studies. Discusses future requirements in racial studies and makes comments, conclusions and recommendations concerning their use.

6792. Schmelz, Gary W. (Thesis, Univ. Delaware, Newark). 1964. A NATURAL HISTORY STUDY OF THE MUMMICHOG, FUNDULUS HETEROCLITUS (LINNAEUS), IN CANARY CREEK MARSH. Biol. Sci., Univ. Delaware, 65 pp.

Fundulus heteroclitus were collected from tidal creeks and salt marsh pools and ditches in the Delaware Bay area from 9 March, 1963, through 16 October, 1963. Salinities ranged from 19.14‰ to 41‰ and temperatures from 6.0° C to 35.5° C.

The diet of F. heteroclitus consisted of aquatic and terrestrial plant material, small crustaceans, insect larvae, mollusks, and fish. Some food items appeared only in the diet of larger fish. These included Uca pugnax, Palaemonetes sp., Limulus sp., Melampus bidentatus, and Menidia sp. The appearance of food organisms in the diet of F. heteroclitus was also influenced by the level of the tides, time of day, and season of the year.

Female F. heteroclitus were found to be slightly larger than males. No differential sex ratio was observed during the collecting period. The smallest sexually mature females were 28 mm in standard length while the largest egg-bearing female was 103 mm in standard length. Spawning was first observed on May 4th and continued through the middle of August. During this time several peaks of spawning activity were observed. These occurred on or near new moon-high tide periods. (Auth.)

6793. Havlena, Frantisek (Lab. Rybárstva, Vurh. Bratislava, Czechoslovakia). 1963. A CONTRIBUTION TO THE NUTRITIONAL BIOLOGY OF SALMO GAIRDNERI IRIDEUS GIBBONS IN PONDS DURING THE WINTER. (PRISPEVOK K POTRAVNEJ BIOLOGII PSTRUHA DUHOVEHO (SALMO GAIRDNERI IRIDEUS GIBBONS) V RYBNÍKY V PRIEBEHU ZIMNIHO OBDOBIA.) Biologia (Bratislava) 18(6): 450-454; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9604. 1964.

In the digestive tract of rainbow trout in winter, Copepoda formed 93% of the food, followed by the Cladocera and Chaoborus. The total weight of the Copepoda increased through the winter from 0.8 to 19.5%; there is a high percentage of trash (67%). The index of fullness of the digestive tract remained constant at 63 throughout the observation period. (Auth.)

6794. Firpichnikov, V. S. 1958. THE COLD RESISTANCE AND WINTER TOLERANCE OF THE YOUNG OF POND CARP, WILD CARP, AND THEIR HYBRIDS. (KHOLODOSTOIKOST' I ZIMOUSTOICHIVOST' MOLODI KARPA, SAZANA I IKH GIBRIDOV.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 8. 261-270; Referat. Zhur., Biol., 1959, No. 93227; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9607. 1964.

The development of carp culture in the north and in Siberia has raised the problem of breeding a winter-resistant variety of carp. The hybrid of a cross between Amur wild carp and pond carp showed a high winter resistance. Amur wild carp and the hybrids are able to resist zero temperature considerably better and longer than pond carp: carp fingerlings died in the first days of the experiment while hybrid fingerlings remained alive more than 28 days. A large accumulation of reserve body substances in the fall and their use at low temperatures is characteristic of the wild carp and the hybrid. The metabolism changes more in relation to environmental conditions; they use less O_2 than pond carp while at rest during the winter. (Courtesy NSF (PL 83-480) 1963.)

6795. Krykhtin, M. L. 1958. THE PECULIARITIES OF THE SPAWNING MIGRATION OF THE SALMON ONCORHYNCHUS MASU (BREVOORT) AND METHODS FOR OBTAINING MATURE SEXUAL PRODUCTS. (OSOBENNOSTI NERESTOVOI MIGRATSII SIMY ONCORHYNCHUS MASU (BREVOORT) I SPOSOBY POLUCHENIYA EE ZRELYKH POLOVYKH PRODUKTOV.) Zool. Zhur. 37(11): 1694-1700; Referat. Zhur., Biol., 1959, No. 67478; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9613. 1964.

The spawning migration of Oncorhynchus masu from the sea to the rivers coincides with the spring floods and relatively low temperatures (12 to 13° C). Their run is intensified during an increase of current speed; the migrating fish rest in places with a slow flow. The intensity of migration during a 24-hour period is lower at higher water temperature. These peculiarities of migration apparently assist the fish to pass difficult places in the river. At the beginning of the migration, fish with sexual products in stages II and II-III of ripeness enter the river; at the height and end of the run fish with sexual products

in stage III enter the river. Fish with sexual products in stage II and III are usually found in the lower and central areas of the spawning rivers, whereas those in stages IV-V are found in the upper parts of the rivers, not far from the spawning sites. Ripe sexual products may be obtained from spawners. The maturing fish must be placed in nursery ponds built in small spring streams with shingly bottom and clean, flowing water of a temperature of 11° C. These ponds must be shaded, 20 to 30 m^2 in area, and 1 m higher than the maximum level of water in the river. The flow must not exceed 0.1 m/sec, and the fish must not be more crowded than 10 specimens per m^2. (Courtesy NSF (PL 83-480) 1963)

6796. Ogata, Tetsuo. 1964. A FEW NOTES OF MIGRATION GROUPS BY ANALYSIS OF SCALE PATTERN ON THE PINK SALMON, ONCORHYNCHUS GORBUSCHA. Bulletin of the Japan Sea Regional Fisheries Research Laboratory, No. 13, pp. 15-24.

The present study was proposed to determine the migration groups of pink salmon, Oncorhynchus gorbuscha, found in the high seas by analysis of scale pattern. Scale samples used as materials were taken in the Japan Sea in 1959-1963, in the south of 48° N of northwestern Pacific Ocean in 1961, and in the coastal areas and rivers of USSR in 1958-1960.

The Japan Sea groups showed generally the same type of scale pattern formation every year and could not be classified clearly into several migration groups. They are of the N-type having a narrow winter band more than 60%. The Pacific Ocean groups, on the other hand, are more than 80% of the W-type having a wide winter band. In these groups, however, it was supposed that there may be several migration groups which are changeable in distribution and scale pattern formation year by year. The circulii in the scale of Japan Sea groups formed in the first oceanic year were comparatively narrower than those of the Pacific Ocean groups. The appearance proportion of D and D'-type showing rapid growth in the second oceanic year varies both by year and by area.

It was consequently determined that: (1) The Japan Sea groups migrate mainly to the Amur, Maritime Province, and the west side of Sakhalin, and partly to the western district of Okhotsk coastal areas. (2) The Pacific Ocean groups found in the south of the 45° N in May and June migrate mainly to the west side of Kamchatka Peninsula and partly to the east side of Sakhalin and the Amur River. (3) The groups found in the areas of 45°-48° N in July migrate to the coast of Okhotsk Sea, the east side of Sakhalin, and the Amur River. (Auth.)

6797. Mansueti, Romeo J. (Chesapeake Biol. Lab., Solomons, Maryland). 1964. EGGS, LARVAE, AND YOUNG OF THE WHITE PERCH, ROCCUS AMERICANUS, WITH COMMENTS ON ITS ECOLOGY IN THE ESTUARY. Chesapeake Science, Vol. 5, No. 1-2, pp. 3-45.

Eggs and larvae were reared in fresh water after stripping and fertilizing ripe ova from known brood fish found spawning in April and May in tidal fresh water. The early developmental stages and transforming postlarvae and very young fish were also identified in ichthyoplankton taken in tidal fresh and slightly brackish water up to 8 0/00 salinity.

The eggs are spherical (except for those with an attachment disk), markedly adhesive, transparent to translucent, relatively small, demersal, and undergo meroblastic cleavage. Average diameters and ranges were: (a) unfertilized egg, 0.79 mm (0.70-0.89); (b) fertilized and water-hardened egg, 0.92 mm (0.75-1.09); (c) yolk mass, 0.70 mm (0.50-0.89); and (d) oil globule, 0.32 (0.20-0.44). Nothing unusual was observed in the embryonic development of white perch eggs.

Prolarvae hatch in about 48 hours at a water temperature of about 63 F. They averaged 2.6 mm (range, 1.7-3.0) total length (T. L.), and are transparent and relatively undeveloped, lack a mouth opening, have non-pigmented eyes, and display a greatly enlarged yolk sac and oil globule beneath the head. Early postlarvae occur when the yolk and oil globule are absorbed at about 3.8 mm T. L., at which size a visibly toothless mouth is developed, and the eyes become pigmented. Sparse pigmentation occurs on the head, oil globule, posterior yolk sac, and edges of the dorsum, ventrum, and hindgut. All larvae hatched in the laboratory died at a size between 4.0 and 5.5 mm T. L. before transformation took place. Transforming postlarvae at the critical stage between 6.0 and 8.0 mm T. L. have not been reared in the laboratory or identified in the plankton.

Late-stage postlarvae, identified from plankton samples, transform to very young fish between 7.0 and 9.0 mm T. L. The heterocercal tail with projecting urostyle assumes a homocercal outline and lepidotrichia are evident in the fins between 10 and 12 mm T. L. Preanal (12) and postanal (13) myotomes correspond to the adult number of vertebrae. As metamorphosis proceeds, the fish become less transparent, pigmentation is more profuse, and they assume an early serranid shape.

Very young fish are relatively short, with a deep caudal peduncle, and usually lack preopercular spines. The third anal spine develops from the first terminally-segmented soft-ray between 20 and 30 mm T. L.; at smaller sizes they possess two anal spines and can be misidentified as a percid fish. Squamation begins between 20 and 25 mm T. L. after which size most of the adult meristic numbers are attained. The profuse but uniform dorsolateral pigmentation is developed at this size interval.

The early stages of white perch were compared critically with those of the striped bass, which is larger at similar stages of development. Important differences in the eggs, prolarvae, postlarvae, and very young fish were found between them. Further data is given that will allow separation of these two species from the early developmental stages of other species that may occur in ichthyoplankton samples

collected in the upper estuaries of the Chesapeake system.

A historical review of sporadic large-scale artificial propagation and stocking of yolk-sac fry of white perch from 1875 to 1936, largely in northern Chesapeake Bay, suggested that no perceptible benefits took place in the commercial catches three to six years later when they would have become 6 to 8 inches long and exploitable. (Auth.)

6798. Mansueti, Alice Jane (Chesapeake Biol. Lab., Solomons, Maryland). 1964. EARLY DEVELOPMENT OF THE YELLOW PERCH, PERCA FLAVESCENS. Chesapeake Science, Vol. 5, No. 1-2, pp. 46-66.

In this study, eggs and larvae of the yellow perch, Perca flavescens, were reared in the laboratory from fertilization to postlarval stages. Fish were sampled at intervals and changes in morphology, anatomy, and general characteristics were described and illustrated. Larvae raised in outdoor hatchery ponds were brought into the laboratory for comparison and to complete developmental descriptions up to the young stages.

Eggs of the yellow perch are extruded in adhesive strands, and in the Chesapeake Bay these strands are found in the shallow, upper reaches of many major tributaries in March and April. Within the first few minutes after fertilization, the eggs "water harden" and expand. Eggs fertilized in this study reached a mean diameter of 2.26 mm; the mean diameter of the yolk was 1.28 mm and the oil droplet was 0.64 mm.

Changes in the egg from fertilization through hatching do not deviate widely from known fish embryology. The most distinctive character of the egg is its thick, elastic case containing minute radial striations. Illustrations of important embryological stages allow easy understanding of the progression in development. Hatching occurs in 27 days at temperatures from 8.5-12.0 C. This incubation period is long when compared to the hatching time of other common estuarine fish.

In this study prolarvae were 5.5-6.0 mm T. L. at hatching. Early prolarvae have an undifferentiated continuous finfold, pigmented eyes, and a series of 15-20 pigment spots along the ventral surface of the tail. The mouth is fully developed at the end of the prolarval stage and although vestiges of yolk remain, active feeding is initiated.

In postlarvae, pigmentation increases over the body, the head becomes more flattened, and a few teeth protrude from the maxillary. Fin formation starts at approximately 11 mm T. L. with differentiation of the basal portion of the caudal fin. The sequence of fin development is: pectorals (within the egg); caudal; anal, second dorsal, some spines of the first dorsal; pelvics; and, finally, the remaining first dorsal spines.

Yellow perch are transformed from the larval stages at approximately 13 mm T. L. when all fins are formed. However, ray elements within the fins are incomplete until the fish reach 21 to 27 mm T. L. At this size the first soft-ray of the anal transforms into a second spine, changing the formula from I, 8-9 to II, 7-8. The formation of distinct body bands begins when the young are about 20 mm T. L. and this pigmentation continues until the vertical bands become a distinct species characteristic. Morphometry, and meristics assume adult proportion near the end of the young stage. Morphometric changes in head length, body depth, and snout-to-vent length are compared. The ossification of a young specimen 17.0 mm T. L., which was cleared and stained with Alizarin red-S, is illustrated.

Habits of cultured fish are briefly mentioned. There was an almost complete lack of feeding success in yellow perch larval stages.

Comparison is made with other work on the yellow perch in the U.S.; excepting hatching size, head contours, and some pigmentation, little difference is noted. Comparison of this study with work from Europe encourages the theory that Perca flavescens and Perca fluviatilis may be conspecific. (Auth.)

6799. Joseph, Edwin B., John J. Norcross, and William H. Massmann (Virginia Inst. of Mar. Sci., Gloucester Point, Virginia). 1964. SPAWNING OF THE COBIA, RACHYCENTRON CANADUM, IN THE CHESAPEAKE BAY AREA, WITH OBSERVATIONS OF JUVENILE SPECIMENS. Chesapeake Science, Vol. 5, No. 1-2, pp. 67-71.

Pelagic eggs collected in Atlantic coastal waters adjacent to Chesapeake Bay have been identified as those of the cobia, Rachycentron canadum (Linnaeus). The egg diameters ranged from 1.16 mm to 1.42 mm with a mean of 1.27 mm. The single large oil globule had a mean diameter of 0.38 mm.

The presence of gravid females and the appearance of cobia eggs in plankton collections indicated that spawning occurs between mid-June and mid-August. Sampling in 1960 showed spawning maxima to be in June and July.

Although virtually all of the cobia eggs were collected in the Atlantic, knowledge of the current patterns in the survey area led to the conclusion that spawning occurred in lower Chesapeake Bay or in the immediate vicinity of the Virginia Capes.

The color pattern and fin shape is described and illustrated from two juvenile cobia collected in August 1962. Observations made before capture of the juveniles point out that certain adult behavioral characteristics are already well established in the first few months of juvenile existence. (Authors)

6800. Smith, Robert E., Donald P. De Sylva, and Richard A. Livellara (Mar. Lab., Univ. Delaware, Newark). 1964. MODIFICATION AND OPERATION OF THE GULF I-A HIGH-SPEED PLANKTON SAMPLER. Chesapeake Science, Vol. 5, No. 1-2, pp. 72-76.

This sampler, a modification of a previous model, has been proven to operate at speeds up to 21 mph. The need for an independent depressor to submerge the sampler has been eliminated by

incorporating trim tabs on the horizontal stabilizers; scope of tow cable (wire angle) can be varied by the position of tow cable attachment and/or trim tab angle of depression. An undisturbed water mass is sampled abeam of the towing vessel during surface collections, when boat is rigged as pictured in the report. This sampler and its associated equipment are relatively simple and inexpensive in design and construction, and in field operation. (Authors)

6801. Dovel, William L. (Chesapeake Biol. Lab., Solomons, Maryland). 1964. AN APPROACH TO SAMPLING ESTUARINE MACROPLANKTON. Chesapeake Science, Vol. 5, No. 1-2, pp. 77-90.

A total approach to sampling macroplankton of the Patuxent Estuary (Chesapeake Bay, Maryland) is presented with gear descriptions, operational details and illustrations. New or modified gear includes: a plankton sled, meter net, mid-depth sampling net, surface sampler, set nets and a field plankton sorter. Flow rate calculations and a laboratory separation technique are also included. (Auth.)

6802. Ross, A. John (Western Fish Disease Lab., Sand Point Naval Air Sta., Seattle, Washington). 1963. MYCOBACTERIA IN ADULT SALMONID FISHES RETURNING TO NATIONAL FISH HATCHERIES IN WASHINGTON, OREGON, AND CALIFORNIA IN 1958-59. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 462, 5 pp.

Incidence of acid-fast bacillus infections in salmonid fishes at West Coast hatcheries was determined for 1957-59. No evidence was obtained which would indicate a definite trend towards either increased or decreased rates of infection. It is apparent that the incidence of infection is higher in hatchery-marked fish than in unmarked fish. Only one hatchery was found free of infection during the 3 years covered by the investigation. This installation had never used raw salmon products in diet. (Auth.)

6803. Fowler, Laurie G., J. Howard McCormick, Jr., and Allan E. Thomas (Salmon-Cultural Lab., Longview, Washington). 1964. FURTHER STUDIES OF PROTEIN AND CALORIE LEVELS OF MEAT-MEAL, VITAMIN-SUPPLEMENTED SALMON DIETS. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 480, 13 pp.

Feeding trials were conducted with fingerlings of fall chinook salmon (Oncorhynchus tshawytscha) to determine the effect of feeding three protein levels, four caloric levels, crystalline vitamins, and meat supplements in a basic meal mixture. After 24 weeks of feeding the results were as follows:

Fish fed at a protein intake of 27.5 percent produced significantly higher protein deposition than did fish fed at protein intakes of 25 and 20 percent, but tended to be less efficient as measured by protein utilization.

Addition of supplemental energy calories in the diets resulted in a sparing action on the protein and vitamin requirements of the fish. The energy requirement of the fish increased, in proportion to the protein requirement, as the fish increased in size.

A crystalline vitamin supplement was inadequate when fed in diets containing a meat supplement.

Meat supplementation ranging from 10 to 50 percent of the meat-meal combination produced no measurable differences in mortality, average weight, protein deposition, or protein utilization.

An all-meal diet produced fish with gains, protein deposition, protein utilization, performances, and general condition as good as or better than fish in comparable diets fed meat supplements. (Authors)

6804. Blaxter, J. H. S. (Mar. Lab., Aberdeen, Scotland). 1964. SPECTRAL SENSITIVITY OF THE HERRING, CLUPEA HARENGUS L. The Journal of Experimental Biology, Vol. 41, No. 1, pp. 155-162.

Herring (Clupea harengus) require light for feeding and avoiding nets. The threshold light intensity for these behavior patterns and also for phototaxis, using different colors of light, was measured and used to obtain spectral sensitivity curves. The maximum sensitivity of dark-adapted herring lay between 510 and 520 mμ. The threshold light intensity, using white light, varied from 3.6×10^{-2} to 2.9×10^{-4} photopic lux, depending on the behavior being studied. A parallel experiment on a dark-adapted human subject gave a maximum sensitivity at 500 mμ and a threshold light intensity, using white light, of 3.4×10^{-7} photopic lux. Pigment extracted from dark-adapted eyes of herring had a maximum absorption at 500 mμ. Suggestions are made for measurement of underwater light intensity in studies on fish behavior. (Auth.)

6805. Fuss, Charles McHatton, Jr. (M. S. Thesis, Southwestern Louisiana Inst., Lafayette). 1959. A LIMNOLOGICAL RECONNAISSANCE OF THREE LOUISIANA LAKES. 48 pp.

The lakes included in this study are Caddo Lake, a large impoundment; Cane River Lake, an old river lake; and Lake Providence, a Mississippi River oxbow lake. The study consists of three major segments, including physical and chemical data, plankton data, and benthos data. The data are presented in an attempt to give a seasonal picture of the fluctuations of chemical, plankton, and benthos quantities. Sampling was conducted quarterly for a period of one year and the procedures are those described by Welch (1948), Langler (1952) and the American Public Health Association (1955).

According to the Forel-Whipple classification, Caddo Lake is a tropical lake of the third order but Cane River Lake and Lake Providence are integrades between the second and third order tropical types. Lake Providence is the only lake in this study that is known to undergo summer thermal

stratification.

Dissolved oxygen peaks occurred in all of the lakes in February, but free carbon dioxide peaks are not well defined and are variable. Bicarbonates constitute the principal source of alkalinity in each lake and the average pH values for Cane River Lake and Lake Providence were greater than 7 and for Caddo Lake, 6.5.

The quantitative plankton cycles are variable and differ from the temperate lakes of the northern United States. In general, net plankton peaks occurred in summer and winter. Cane River Lake was highest in annual net plankton and Caddo Lake, in nannoplankton production. (Auth. abst.)

6806. Hoffpauir, Donald Morgan (M. S. Thesis, Univ. of Southwestern Louisiana, Lafayette). 1963. THE DISTRIBUTION OF FISHES OF THE MERMENTAU DRAINAGE IN ACADIA PARISH, LOUISIANA. 41 pp.

The purpose of this project was to determine, as completely as possible, the fish species composition of the Mermentau drainage in Acadia Parish. Fish were taken from the major streams, secondary streams, and irrigation canals. Sixteen collecting stations, representing all sections of the parish, were used. Fish were collected primarily by the use of seines. Attention was paid to vegetation, stream bottom, shore, stream width, depth of water, depth of capture, and water and air temperatures. Specimens were fixed in the field in a ten percent formalin solution, later removed and placed in a fifty percent isopropyl alcohol solution.

This survey yielded a total of forty-three species in fifteen families. None of the species were new records for the State of Louisiana. Family Centrarchidae, represented by eleven species, had the largest number of species. Family Cyprinidae had nine representatives and was second. Family Ictaluridae was represented by five species; families Cyprinodontidae and Percidae were represented by three species each; families Poeciliidae and Lepisosteidae were represented by two species each; and families Polyodontidae, Amiidae, Clupeidae, Catostomidae, Aphrododeridae, Sciaenidae, Mugilidae, and Atherinidae were represented by one species each. (Auth. abst.)

6807. Jean, Yves (Fish. Div., Dept. of Industry and Commerce, Quebec, Canada). 1964. SEASONAL DISTRIBUTION OF COD (GADUS MORHUA L.) ALONG THE CANADIAN ATLANTIC COAST IN RELATION TO WATER TEMPERATURE. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 429-460.

Seasonal relationships between size, bottom temperature, and distribution of cod are described for the western Gulf of St. Lawrence and Nova Scotia Banks.

In summer, in the western Gulf of St. Lawrence, cod are distributed from 35 to 145 m at bottom temperatures from -0° to 6° C. They are most abundant at about 100 m where the temperature is around 1° C. In winter they are concentrated in 130-180 m along the western slope of the Laurentian Channel at bottom temperatures from 1° to 3° C.

On the Nova Scotia Banks cod are less abundant than in the Gulf of St. Lawrence. They are found mainly around Banquereau, Middle Ground, and the northern edges of Sable Island Bank. Further to the west cod are replaced by haddock as the dominant species. Nova Scotia Banks cod are found in shallower and warmer waters than Gulf cod, both in summer and winter. In summer they are present from 65 to 110 m at bottom temperatures varying from about 1° to 8° C. In winter they are taken primarily at 90-135 m at bottom temperatures from 2° to 4° C.

Area and depth distributions of commercial catches reflect the seasonal pattern of cod migrations and distributions demonstrated in surveys and tagging studies. (Auth. abst.)

6808. Larkin, P. A. (Fish. Res. Bd. of Canada Biol. Sta., Nanaimo, B. C., Canada), R. F. Raleigh, and N. J. Wilimovsky. 1964. SOME ALTERNATIVE PREMISES FOR CONSTRUCTING THEORETICAL REPRODUCTION CURVES. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 477-484.

Various types of reproduction curves have found extensive use in management and analysis of fish populations. To these may be added curves based on depensatory processes of mortality. Life-history stages may be considered as successive "stock and recruitment" relationships, the output from one process comprising the input of the next. A variety of reproduction curves can thus be generated by considering differing sequences of compensatory and/or depensatory processes. (Auth. abst.)

6809. Hartman, Wilbur L. (U. S. Bur. Comm. Fish., Biol. Lab., Auke Bay, Alaska), and Robert F. Raleigh. 1964. TRIBUTARY HOMING OF SOCKEYE SALMON AT BROOKS AND KARLUK LAKES, ALASKA. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 485-504.

The degree of preference of sockeye salmon (Oncorhynchus nerka) for spawning in specific tributaries to Brooks and Karluk Lakes, Alaska, was studied in 1960 and 1961. Adult sockeye salmon begin to congregate around stream mouths soon after entering these lakes. At Brooks Lake, groups of fish were seined from various stream mouths and marked with distinctive tag color combinations. One group of tagged fish from each seine haul was released back into the original donor congregation as a control, and one or more groups were transported and released into congregations around other tributary mouths. Strength of tributary preference was determined by comparing the number of fish from each group distributed on the various spawning grounds. Eighty-three

percent of the 958 fish tagged were recovered at weirs and on stream and lake surveys. Distribution to spawning areas of sockeye salmon in control and transported groups was virtually identical. The study at Brooks Lake was followed by a study at Karluk Lake to explore further the strength of tributary preference. Very few sockeye salmon experimentally prevented from entering their preferred tributary chose an alternative spawning area. Most continued to attempt to enter their blocked tributary until death. A final study at Karluk Lake confirmed the fact that sockeye salmon entering the lake were predisposed to spawn in a particular tributary and could not be conditioned to enter an alternative tributary. We conclude that sockeye salmon are indeed homing to particular tributaries in these small lakes. The biological and management implications of these findings are discussed. (Authors)

6810. Gilmartin, Malvern (Inst. of Oceanography, Univ. of British Columbia, Vancouver 8, B. C., Canada). 1964. THE PRIMARY PRODUCTION OF A BRITISH COLUMBIA FJORD. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 505-538.

An annual cycle of primary production was established for a British Columbia fjord. Detailed oceanographic analyses of the total oxygen budget of the fjord provided a biological oxygen budget that was further apportioned into estimations of the gross primary production (24), net primary production (24), and subeuphotic utilization of organic material. The values for 1958-59 were 671, 381, and 290 g $C/m^2/yr$, respectively. Using C^{14} data, corrected for observed respiration and variations in insolation, 24-hr gross and net primary production estimations of 609 and 455 g $C/m^2/yr$ were derived. Over 90% of the year's primary production was attributed to the nannoplankton. The relation between the physical environmental factors of the fjord and primary production is discussed. (Auth. abst.)

6811. Lawler, G. H. (Fish. Res. Bd. of Canada, Biol. Sta., London, Ont., Canada). 1964. INCIDENCE OF LIGULA INTESTINALIS IN HEMING LAKE FISH. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 549-554.

Ligula intestinalis is found in a few species of Heming Lake fish, but occurs principally in the spottail shiner, Notropis hudsonius. A list of possible adult hosts is given. The largest Ligula, 91.4 cm long, was found in a sucker 29.5 cm long. Annual and regional differences in the incidence of Ligula in spottail shiners are noted. It is apparent that at Heming Lake, as in other regions, a large population of aquatic birds is not required to produce a high incidence of Ligula in fish. (Auth.)

6812. Pitt, T. K. (Fish. Res. Bd. of Canada, Biol. Sta., St. John's, Newfoundland). 1964. FECUNDITY OF THE AMERICAN PLAICE, HIPPOGLOSSOIDES PLATESSOIDES (FABR.) FROM GRAND BANK AND NEWFOUNDLAND AREAS. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 597-612.

Fecundity estimates were made on a total of 140 mature American plaice from the southern and northern slopes of the Grand Bank and from St. Mary's Bay. Log-log relationships were established between fecundity and fish length, gutted and gilled weight, age, and ovary weight. No differences were found to exist between the fecundity-length relationship of plaice from the three areas, but there is a suggestion that within areas there may be annual differences in egg production. At comparable ages plaice from the southern slope of the Grand Bank are larger in size and produce more eggs than those from the northern slope and St. Mary's Bay. (Auth.)

6813. Hunter, John R. (U. S. Bur. Comm. Fish., San Diego, California), and Warren J. Wisby. 1964. NET AVOIDANCE BEHAVIOR OF CARP AND OTHER SPECIES OF FISH. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 613-633.

The net avoidance behavior of carp, Cyprinis carpio Linnaeus, was studied in the laboratory. The effect of the size of the tank, temperature, light, social behavior, and air bubbles was evaluated and the behavior of carp was compared to that of nine other species of fresh-water fishes.

Carp tended to escape a net in the same relative position in tanks of different lengths. Fish in cold water used a bottom escape route while those in warm water used an escape route located at the top of the net. Groups were more successful in avoiding a net than were isolates. In warm water there was an immediate difference between the performance of groups and isolated fish; in cold water differences appeared after training. Blind carp and carp tested in turbid water were less successful in avoiding a net than were fish with unimpaired vision. Groups of carp avoided portions of an escape route which were occluded by air bubbles. (Authors)

6814. Tsuyuki, H., P. J. Schmidt, and M. Smith (Fish. Res. Bd. of Canada, Technol. Research Lab., Vancouver, B. C., Canada). 1964. A CONVENIENT TECHNIQUE FOR OBTAINING PITUITARY GLANDS FROM FISH. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 635-637.

A convenient and rapid technique for obtaining large numbers of pituitary glands is described. The apparatus consists of a power- or hand-driven laboratory cork borer with a moveable piston for ejecting the core, which is then sliced cross-sectionally with a knife. The brain tissue is removed, and the pituitary gland is collected with a suitably shaped probe.

6815. Hardy, Robert A. (Inst. of Oceanography, Dalhousie Univ., Halifax, Nova Scotia). 1963. A VACUUM-ASSISTED SUBSAMPLER FOR USE

WITH SMALL PLANKTONIC ORGANISMS. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 639-640.

The subsampler consists of a glass tube connected to an aspirator by a length of flexible tubing fitted with a squeeze-bulb and a spring-loaded pinchcock.

6816. Keleher, J. J. (Fish. Res. Bd. of Canada, Biol. Sta., London, Ontario, Canada). 1964. ANGLING LICENSE SALES FROM NORTHWEST TERRITORIES, CANADA, WITH SPECIAL REFERENCE TO GREAT SLAVE LAKE. Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 643-645.

During the twelve-year period for 1950-51 to 1961-62, 7603 licenses were issued. Generally, sales have increased annually but at an uneven rate. Forty-three percent of the licenses were secured at DEW Line radar sites and forty percent at the Great Slave Lake region. Canadian residents accounted for three-fifths of the license sales in the Great Slave Lake region.

6817. Jonas, R. E. E., and E. Bilinski (Fish. Res. Bd. of Canada, Technol. Research Lab., Vancouver, B. C., Canada). 1963. UTILIZATION OF LIPIDS BY FISH. III. FATTY ACID OXIDATION BY VARIOUS TISSUES FROM SOCKEYE SALMON (ONCORHYNCHUS NERKA). Journal of the Fisheries Research Board of Canada, Vol. 21, No. 3, pp. 653-656.

The fatty acid oxidizing ability of six different tissues from both juvenile and adult fish are compared. Data on the formation of $C^{14}O_2$ from acetate 1-C^{14} show highest activity in kidney in both adult and juvenile sockeye salmon. Lower activity is found in liver, heart, and lateral line muscle, whereas brain and dorsal muscle show only a very limited ability to oxidize acetate. Results reveal a spectrum of activities in the various tissues which is very similar in juveniles and adults.

6818. Lawrence, J. M. (Alabama Agric. Exp. Sta., Auburn). 1962. AQUATIC HERBICIDE DATA. Agric. Handbook, U. S. Dept. Agric., 231, p. 133; Weed Abstracts, Vol. 12, No. 5, Abst. No. 1312. 1963.

This handbook brings together and summarizes technical data reported in the world literature. The first section lists the chemicals for which data are available and the genera of algae and higher plants for which data from screening and field trials exist. The next section gives data of the toxicity of aquatic herbicides to fish and fish food organisms. There follows a section on the effect of aquatic herbicides on various algae, including tables giving data of the effect of dichlone, phenanthraquinone, $CuSO_4$ and chlorine. The main section is devoted to the effects of various herbicides on submersed, emergent, ditch-bank, floating, and miscellaneous weeds and there is bibliography of 253 items.

6819. Hughes, E. C. (Summarizer) 1961. AQUATIC WEED CONTROL. Res. Rep. W. Sect. Nat. Weed Cttee., Canada, 107-113; Weed Abstracts, Vol. 12, No. 5, Abst. No. 1314. 1963.

Endothal (liquid), applied at 3.2 ppm over the surface of shallow water at Norris Lake and endothal (granular) at 2 ppm gave good control of submerged pondweeds (Potamogeton spp.) but not of emerged plants of water lily (Nuphar spp.). Scirpus spp. at the heading stage responded well to endothal (liquid) at 6# and almost complete kill followed treatment with fenoprop at 4# and with dalapon 15# + 2,4-D ester 4#. Dalapon + 2,4-D and Garlon (fenoprop + dalapon esters) 4# also controlled Carex spp. and Typha spp.

Aqualin (acrolein 85%) at 5 ppm, applied through the water at Pike Lake, Saskatchewan, controlled Potamogeton spp. and Myriophyllum exalbescens treated before flowering and there was little regrowth 6 weeks after applying the treatment. Complete kill of Potamogeton spp. and Cladophora spp. was given at Lake Katepwa by a concentration of 6.3 ppm. Control of Lemna spp., Anacharis spp., and Carex spp. in ponds was obtained with 9 ppm. The rate of flow of water in irrigation canals in S. Alberta was increased following introduction of Aqualin at a measured rate to control Potamogeton spp. and Vallisneria spp. Invertebrate fauna in Lake Wabamun appeared to suffer no ill effects when Aqualin was applied in a concentration of 6.8 ppm, but fish tended to avoid the treated area.

Sodium arsenite at 6.2 ppm gave complete control of large populations of pond algae and prevented heading of Typha spp. growing on the pond margins.

6820. Timmons, F. L. (Crops Res. Div., Agric. Res. Serv., U. S. Dept. Agric., Beltsville, Maryland). 1963. AQUATIC WEED CONTROL AND RESEARCH IN THE WEST. Proc. 16th Southern Weed Conf., 354-355; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1663. 1963.

Research on aquatic weed control carried out since 1957 by the Agricultural Research Service and the Bureau of Reclamation is briefly reviewed. Successful herbicidal techniques evolved include the use of xylol-based aromatic solvents and emulsifiers and acrolein to control submerged weeds, and 2,4-D, amitrole and dalapon to control cattail (Typha sp.) in drainage canals. Current investigations in the West include (1) control of submerged weeds in large canals flowing at 300-11,000 cu. ft/sec, (2) control of submerged weeds in lakes and reservoirs, and (3) control of semi-aquatic bank weeds, such as Carex spp., quackgrass (Agropyron repens) and reed canary grass (Phalaris arundinacea).

6821. Blackburn, R. D. (U. S. Dept. Agric., Ft. Lauderdale, Florida). 1963. EVALUATING HERBICIDES AGAINST AQUATIC WEEDS. Weeds, 11, 1, 21-24; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1664. 1963.

Techniques are described for evaluating the effectiveness of herbicides against aquatic weeds in

the laboratory.

6822. Steenis, J. H., and V. D. Stotts (Patuxent Wildlife Res. Center, Laurel, Maryland). 1963. PROGRESS REPORT ON DISTRIBUTION AND CONTROL OF EURASIAN WATER MILFOIL IN THE CHESAPEAKE BAY REGION, 1962. Proc. 16th Southern Weed Conf., 341-342; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1667. 1963.

Optimum control of Myriophyllum spicatum with granulated 2,4-D ester at 20-30# was obtained at the end of May/beginning of June, where the water temperature was >18° C and the vegetation was sufficiently dense to form a loose mat of growth extending from top to bottom of the water. Treatments made earlier in the year or after flowering were ineffective. In well-protected embayments, treatments with 20# were effective, irrespective of tide, but in areas exposed to extremes of tide and wind, best results were obtained with 30# applied just before dead low tide. Diquat and endothal + fenoprop potassium showed promise in tidal conditions, whereas fenac sodium was not effective in tidal areas, but showed promise in non-tidal areas.

6823. Haven, D. (Virginia Inst. Marine Science, Gloucester Point). 1963. MASS TREATMENT WITH 2,4-D OF MILFOIL IN TIDAL CREEKS IN VIRGINIA. Proc. 16th Southern Weed Conf., 345-350; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1668. 1963.

In trials in a tidal water creek 1200 ft long, 100 ft wide and 2-6 ft deep, where water salinity was 8000 ppm and water temperature was 70° F, 700 lb of pelleted 2,4-D 2-ethyl hexyl ester (20% a. e.) applied at the end of May broke up a dense infestation of Myriophyllum spicatum within 3 days. Leaves and stems disintegrated after 2 weeks and roots were killed by September. Along the shore in treated areas, dense stands of Potomogeton perfoliatus and Ruppia maritima appeared by late autumn. In a further trial, over 99% of an infestation of M. spicatum disintegrated within 2 weeks after applying 2,4-D (20% a. e.) at 50#. The number of living organisms in or on mud, particularly Leptocherius plumulorus (an amphipod) and Macoma baltica (a mollusc), was drastically reduced within 2 weeks and remained at a low level for 4 months. It was concluded that decaying plant vegetation formed an anaerobic layer isolating organisms from well-oxygenated water.

6824. Smith, G. E. (Div. Health, TVA, Wilson Dam, Alabama). 1963. CONTROL OF EURASIAN WATER MILFOIL (M. SPICATUM) IN TVA RESERVOIR. Proc. 16th Southern Weed Conf., 351-353; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1669. 1963.

In a preliminary trial in 1962 in the Watts Bar Reservoir, 2,4-D 2-ethyl hexyl ester (20% a. e.) impregnated on 8/15 mesh granules, applied by helicopter on April 3 when the lake was 6 ft below summer levels, gave complete control of a dense infestation of Myriophyllum spicatum within 6 weeks. In both the Watts Bar and Chickamauga Reservoirs, de-watering has reduced the stand of M. spicatum and the normal draw-down period (approximately 5 months) in the winter kills most plants established above the draw-down zones. In a pot trial, de-watering for only 21 days sufficed to kill M. spicatum.

6825. Lawrence, J. M., P. G. Beasley, and H. H. Funderburk (Alabama Agric. Exp. Sta., Auburn). 1963. WATER INVESTIGATIONS ON HERBICIDAL ACTIVITY OF CASORON, BANVEL D, CHLOROPHENOXY, AND OTHER COMPOUNDS ALONE AND IN COMBINATIONS ON ALLIGATORWEED. Proc. 16th Southern Weed Conf., 368-369; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1670. 1963.

In pot trials in which node cuttings of Alternanthera philoxeroides were set in soil, flooded with water maintained at 70-90° F, and illuminated at 800 ft candles for 14 hr/day for 2 months before treatment, (a) dichlobenil ± 2,4-D butyl ether ester (BEE) or propylene glycol butyl ether ester (PGBEE) ± disodium methyl arsenate (DMA) and (b) Banvel D (2-methoxy-3,6-dichlorobenzoic acid) ± DMA ± 2,4-D BEE or PGBEE, both at 2# in 50 gal of an acetone/water solution, were effective when sprayed to the upper third of the plants or onto the water. The following herbicides were effective applied at 10# (equivalent to 2 ppm of a. i.) to plants rooted in soil in plastic pools, then flooded to a depth of 24 in.: dichlobenil, Banvel D, 2,4-D and fenoprop BEE and PGBEE, fenac and CP 522 (trichlorophenyl acetonitrile). Dichlobenil severely injured the nodes and maintained bud dormancy for 16 weeks. The nodes of Banvel D-treated plants became swollen and partially desiccated, and while some new growth arose from buds dormant at the time of treatment, this became chlorotic at the 4-leaf stage.

6826. Weldon, L. W., R. D. Blackburn, and D. E. Seaman (Crops Res. Div., U. S. Dept. Agric., Ft. Lauderdale, Florida). 1963. STUDIES ON THE CONTROL OF WATER LETTUCE. Proc. 16th Southern Weed Conf., 356; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1672. 1963.

In trials carried out since 1958 on the control of Pistia stratiotes in canals and irrigation ditches, diquat at 1-1.5# has given best results (98-100% control) with the dibromide or dichloride formulations appearing equally effective. No benefit was gained by adding a wetter. MCPA at 8# in diesel oil at 10 gal/ac was as effective as 2,4-D at twice this rate. A tertiary fatty acid amine of MCPA without an emulsified oil has also been effective.

6827. Snow, J. R. (U. S. Bur. Sport Fish. & Wildl., Marion, Alabama). 1963. A PRELIMINARY REPORT ON THE CONTROL OF PITHOPHORA WITH SIMAZINE. Proc. 16th Southern Weed Conf., 329-335; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1673. 1963.

Simazine at 2 ppm, applied on July 26, 1961, to moderate infestations of Pithophora in fish

hatchery ponds, had a rapid initial effect on the algae, but regrowth appeared within 6-8 weeks. In one pond where water was shallow, oxygen depletion occurred and several adult redear sunfish (Lepomis microlophus) were killed, though no small fish died. In trials the following year in ponds containing L. microlophus and bluegills (L. macrochirus), simazine at 3 ppm applied on May 22 gave satisfactory kill of Pithophora without causing oxygen depletion or injuring the fish. A split application of simazine at 1 and 2 ppm applied in July with an interval of 8 days between treatments, or single applications of 3 ppm in September or October, were less effective. Simazine at 3 ppm noticeably reduced the amount of phytoplankton developing for up to 4-6 weeks. The number and weight of fingerlings harvested from treated ponds was relatively low.

6828. Shell, E. W. (Alabama Agric. Exp. Sta., Auburn). 1962. HERBIVOROUS FISH TO CONTROL PITHOPHORA SP. AND OTHER AQUATIC WEEDS IN PONDS. Weeds, 10, 4, 326-327; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1674. 1963.

Pithophora sp. were eliminated from ponds stocked with the Israeli strain of common carp (Cyprinus carpio), though breaking up of the mats during feeding was probably more important in controlling the alga than was ingestion. High rates of stocking with 3- to 4-in. fingerlings of Nile tilapia (Tilapia nilotica) or Java tilapia (T. mossambica) were also effective. In all instances successful control depended on the ponds not containing bluegill or more than a few largemouth bass. Nile tilapia also controlled Potamogeton sp., Eleocharis sp., and Najas sp. Neither Nile nor Java tilapia survive winter in Alabama so that restocking of the ponds is necessary each spring. Preliminary results with Congo tilapia (T. melanopleura) suggest that this species also gives some control of bladderwort (Utricularia sp.) and parrot feather (Myriophyllum brasiliense).

6829. Blackburn, R. D., and L. W. Weldon (Crops Res. Div., U. S. Dept. Agric., Fort Lauderdale, Florida). 1963. RESULTS OF 3 YEARS OF TESTING DIQUAT AS AN AQUATIC HERBICIDE IN FLORIDA. Proc. 16th Southern Weed Conf., 365; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1675. 1963.

Diquat at concentrations down to 0.25 ppmw controlled submerged weeds in small ponds. In canals in S. Florida where flow could be stopped for 24-36 hr, 1 ppmw controlled Najas guadalupensis and Ceratophyllum demersum; higher concentrations were required for complete control of dense stands of Elodea densa. Floating species, such as Eichhornia crassipes, Pistia stratiotes, and Salvinia rotundifolia, were controlled with rates of 1-1.5#, but treatment was required for complete control. Foliar sprays of 10# gave initial top-kill of Alternanthera philoxeroides, but submerged stems regrew within 2-3 weeks. In laboratory trials, Spirodela polyrhiza was killed by 0.05 ppmw, but in field trials, 0.25 ppmw was required to control several other duckweed species. Concentrations of 0.5 ppmw appeared to have little effect on natural fauna and plankton in small ponds. Concentrations up to 2.5 ppmw persisted in pond water for up to 11 days, but these were not toxic to fish.

6830. Lawrence, J. M., P. G. Beasley, and H. H. Funderburk (Alabama Agric. Exp. Sta., Auburn). 1963. WATER QUALITY IN PLASTIC POOLS, CONTAINING AQUATIC PLANTS, BEFORE AND AFTER TREATMENTS WITH BIPYRIDYLIUM COMPOUNDS. Proc. 16th Southern Weed Conf., 366-367; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1676. 1963.

In studies in which total alkalinity, total hardness, resistivity, and concentration of calcium, potassium, and sodium were determined from samples of water collected 2, 4, 8, and 16 weeks after applying diquat and paraquat at concentrations of 0.125-0.5 ppm, the only apparent change in the chemical composition of the water after treatment was an increase in potassium concentration resulting from plant decomposition.

6831. White, A. C. (Ortho Div., California Chem. Co., Orlando, Florida). 1963. DIQUAT AND PARAQUAT SYNOPSIS OF AQUATIC WEED EXPERIMENTS. Proc. 16th Southern Weed Conf., 357-364; Weed Abstracts, Vol. 12, No. 6, Abst. No. 1677. 1963.

The chemical and physical properties, toxicity, and mode of action of diquat and paraquat are briefly reviewed, and a summary is given of the results of various trials on the control of Alternanthera philoxeroides, Chara spp., Lemna minor, Spirodela spp., Wolffia spp., Pithophora spp., Myriophyllum spp., Potamogeton spp., Heteranthera dubia, Salvinia rotundifolia, Eichhornia crassipes, Pistia stratiotes, Elodea densa, and E. canadensis with both paraquat and diquat, and of Ceratophyllum demersum, Najas guadalupensis, and Ruppia spp. with diquat. Diquat and/or paraquat have also shown promise in controlling Utricularia spp., Hydrochloa caroliniensis, Scirpus eriophorum, Hydrodictyon sp., Bacopa rotundifolia, Ranunculus spp., Sagittaria latifolia, Spirogyra spp. and Panicum repens.

6832. Hiltibran, R. C. (Nat. Hist. Survey, Urbana, Illinois). 1962. CHEMICAL AQUATIC WEED CONTROL IN ILLINOIS FARM PONDS. Proc. 19th N. Cent. Weed Control Conf., 28-29; Weed Abstracts, Vol. 13, No. 1, Abst. No. 136. 1964.

Diquat at a concentration of 0.5 ppm proved effective during 1961-1962 in controlling Potamogeton pectinatus, P. foliosus, P. crispus, and Ranunculus trichophyllus and at 1.5 ppm controlled Myriophyllum exalbescens and Najas flexilis. Regrowth of Elodea canadensis occurred in the year following treatment with 1 ppm. The following rates eradicated the emergent species named: Sagittaria latifolia 100 ml, Justicia americana 50 ml, Jussiaea repens var. glabrescens 50 ml, Typha latifolia 60

ml, T. angustifolia 60 ml/gal, plus detergent. P. nodosus was resistent to 100 ml/gal of diquat dibromide formulated at 4 lb/gal of commercial product and Cabomba caroliniana to 3 ppm.

Fenoprop liquid or granular at 3 ppm controlled M. exalbescens. S. latifolia, J. americana, and Jussiaea repens responded to foliar application of 25 ml/gal of liquid formulation, but J. repens required 2 lb of granules per 400 sq. ft. Equivalent rates of salts and esters seem equally effective.

Liquid formulations of endothal mono- and di-N,N-dimethylcocoamine at 1 ppm controlled P. pectinatus and 4 ppm damaged C. caroliniana. Granular endothal mono-N,N-dimethylcocoamine at 2 ppm damaged Chara spp. Repeated applications of either salt reduced infestation by Lemna minor.

Two annual applications of endothal during 1960-1962 failed to eradicate P. crispus treated before fruiting bodies developed. Good control of P. nodosus was given by endothal liquid at 2 lb/gal applied to floating leaves and by granular endothal at 1-2 ppm.

6833. Walker, C. R., and H. L. Lindaberry (Fish Control Lab., La Crosse, Wisconsin). 1962. POND RENOVATION WITH PENCO HERBICIDE 47 AND PENCO POND RENOVATOR. Proc. 19th N. Cent. Weed Control Conf., 27; Weed Abstracts, Vol. 13, No. 1, Abst. No. 137. 1964.

Endothal di-N,N-dimethylcocoamine (Herbicide 47), thoroughly mixed with water in ponds to give an overall concentration of 0.6 ppmw, controlled Potamogeton, Najas, Ceratophyllum, and Myriophyllum spp. As little as 0.1 ppmw controlled Chara and Nitella spp. Endothal + rotenone (Penco Pond Renovator) combined piscicidal qualities with effectiveness against aquatic weeds at lower concentrations than endothal alone.

6834. Émond, G. (Minist. Agric. Colon. Quebec, 201 est blvd Crémazie, Montreal 11, Canada). 1963. ACROLEIN AS A CHEMICAL HERBICIDE FOR SUBMERGED AQUATIC PLANTS. Phytoprotection, 44, 2, 65-68; Weed Abstracts, Vol. 13, No. 1, Abst. No. 138. 1964.

Trout and salmon were killed within 1 hr of applying Aqualin (acrolein 85%) over the surface of standing water to give a concentration of 13 ppm in a pond at the Quebec Fish Hatchery, Baldwin Mills. Green, filamentous algae disintegrated in 4-5 days and Elodea canadensis in 2 weeks. Low water temperatures at the time of treatment retarded but did not diminish its effectiveness.

6835. Walker, C. R. (Fish Control Lab., La Crosse, Wisconsin). 1962. THE TOXICOLOGY AND HERBICIDAL EFFECTIVENESS OF SIMAZINE AND SEVERAL s-TRIAZINE COMPOUNDS AS AQUATIC HERBICIDES IN FISHERIES HABITAT. Proc. 19th N. Cent. Weed Control Conf., 28; Weed Abstracts, Vol. 13, No. 1, Abst. No. 139. 1964.

Simazine granular applied pre-em. to give a concentration of 1-2 ppmw controlled Potamogeton, Najas, Ceratophyllum, Heteranthera, and Zannichellia spp. in fish ponds. Cladophora spp. Pithophora spp. and Chara vulgaris responded to 2 ppm. Early post-em. treatment with wettable powder was also effective. Atrazine at 0.5-1 ppm gave some control of algae and Potamogeton spp. in ponds, sprays being more effective than granular treatments. No control was obtained with propazine or prometon at concentrations up to 3 ppm.

Simazine was the least toxic to fish of the compounds examined and granular formulations were generally less toxic than were wettable powders. The carrier used in applying granular formulations had a considerable influence on toxicity.

6836. Walker, C. R. (Fish Control Lab., La Crosse, Wisconsin). 1962. THE USE OF DICHLOBENIL FOR THE CONTROL OF AQUATIC WEEDS IN FISHERIES HABITAT. Proc. 19th N. Cent. Weed Control Conf., 30; Weed Abstracts, Vol. 13, No. 1, Abst. No. 140. 1964.

Some control of submersed Potamogeton spp. and Najas flexilis was given to pre-em., but not by post-em., application of granular dichlobenil (4%) at 20-40#, but filamentous algae and Chara vulgaris were resistant. Ceratophyllum demersum was affected only by the highest rate of treatment. Pre-em. application of a wettable powder to exposed bottom soil prior to refilling a drained pond was also effective. Median tolerance limits of 10-20 ppmw were established for fish (Lepomis spp. and Micropterus salmoides) in laboratory testing.

6837. Foret, J. A., and F. W. Zur Burg (Univ. S. W. Louisiana, Lafayette). 1963. 2,4-D AND A CHELATING AGENT AS A HERBICIDAL SPRAY ON FLOATING MATS OF ALLIGATORWEED. Proc. 16th Southern Weed Conf., 328; Weed Abstracts, Vol. 13, No. 1, Abst. No. 141. 1964.

In preliminary glasshouse screening trials in 1961, acetic acid at concentrations of between 500 and 1000 ppm adversely affected Alternanthera philoxeroides. In field trials, invert emulsions of 2,4-D propylene glycol butyl ether (PGBE) ester at 15#+acetic acid at 450# destroyed submerged stems in floating matted clumps. In further trials in April the following year, A. philoxeroides treated with 2,4-D PGBE ester at 15# + ethylenediaminetetra-acetic acid (as Versene) at 20# showed chlorosis of special meristems, leaves, and nodal regions, in addition to characteristic responses to 2,4-D, but applications in May were ineffective. Under glasshouse conditions, the chlorosis symptoms were similar to those caused by manganese deficiency and the entire plant collapsed within 3 weeks. Subsequent field applications made in August, October, and November increased the control of submerged stems from 30 to 80% with each successive treatment.

6838. Carlson, Clarence Albert, Jr. (Ph. D.

Thesis, Iowa State Univ. of Sci. and Technol., Iowa City). 1963. BOTTOM FAUNA OF THE MISSISSIPPI RIVER NEAR KEOKUK, IOWA, WITH PARTICULAR REFERENCE TO POSSIBLE CONTROL OF EPHEMEROPTERA AND TRICHOPTERA. Dissert. Abstracts, Vol. XXIV, No. 10, p. 4320. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-3977, 208 pp. (Microfilm $2.75; Xerography $9.45).

This study was begun in 1960 to determine the possible effects of chemical removal of immature mayflies and caddisflies from the Mississippi River near Keokuk, Iowa. Mayfly populations of Pool 19 were estimated by collection of naiads in the upper, middle, and lower portions of the pool and were found to be much higher in 1960 than in 1959 or 1961. Habitat was destroyed, and mayfly naiads probably were washed downstream by floods in upper Pool 19 in the spring of 1960. Over 1400 benthos collections were made from eight sampling locations along the Illinois shore above Dam 19 in the summers of 1960 and 1961. No significant difference was found in numbers of organisms collected after sifting Ekman dredge contents through 20- and 40-mesh screens. The community present in the study area is characteristic of the climax of large rivers. Major elements of the benthos have changed little in the last 30 years. Hexagenia spp., Sphaerium transversum, Campeloma spp., Lioplax subcarinata, oligochaetes, and larvae of several species of chironomids were the organisms collected most frequently and in greatest numbers. Somatogyrus depressus and Oecetis sp. b were also abundant at times. An average of 272 organisms was collected per square foot at the study area. Sphaerium transversum was the most abundant organism, and was the only organism collected at every sampling area on each collection date. Hexagenia naiads were the most abundant insects at all locations in 1960. Tendipes plumosus became the most abundant insect in 1961 at the part of the study area nearest Dam 19. As the most abundant insects emerged during the summer, other elements of the benthos increased in abundance. Several organisms were more abundant in 1961, when mayfly populations were low, than in 1960. A nutrient and energy flow diagram was prepared to show the probable roles of various organisms in the ecology of the study area. Techniques for successfully transporting, storing, and handling immature mayflies and caddisflies and a procedure for bioassays involving these insects were devised. Caddisfly larvae were killed by concentrations of Dylox and Co-ral at levels low enough to provide safe treatment without killing fishes, but the margin with Malathion was only about 13 to 1. The small differences in the toxicity of Dylox, Co-ral, and Malathion to mayfly naiads and to fishes indicated that the search for a chemical with a greater degree of selective toxicity to mayflies should be continued. Mayfly naiads were found to be rather tolerant to the chemicals used in bioassays, and, since they often remained capable of movement even in high concentrations of toxicants, it was necessary to exercise judgment as to their ability to recover. Additional toxicity experiments under simulated natural conditions are recommended. Attempts at widespread control of either mayflies or caddisflies are not recommended at this time because of potential danger to human populations and the likelihood of disturbance of the biological balance. (Auth. abst.)

6839. Bane, Gilbert Winfield, Jr. (Ph. D. Thesis, Cornell Univ., Ithaca, New York). 1963. THE BIOLOGY OF THE YELLOWFIN TUNA, THUNNUS ALBACARES (BONNATERRE), IN THE GULF OF GUINEA. Dissert. Abstracts, Vol. XXIV, No. 10, p. 4317. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-3702, 444 pp. (Microfilm $5.65; Xerography $20.05).

The yellowfin tuna, Thunnus albacares, was studied in the Gulf of Guinea aboard commercial fishing vessels in 1959, 1960, and 1961.

The external and internal morphology was studied in detail. Covariance analyses were made on several biometric characters and the results were compared with the yellowfin tuna from other areas. Yellowfin tuna from the Gulf of Guinea showed strong affinities with the yellowfin tuna from both Angola and the western Atlantic Ocean. Large differences were noted between the yellowfin tuna from the Atlantic Ocean and those from the Pacific Ocean.

Meterological and hydrographic data, collected during the cruises were averaged by one degree latitude and longitude within the Gulf of Guinea. These included wind direction and velocity, air temperature, precipitation, cloud cover, currents, stratification of water, swell, sea temperature, salinity, density, and zones of upwelling.

A positive relationship was observed when the abundance of the yellowfin tuna was compared to cloud cover. There was no apparent relation between sea surface temperature and yellowfin distribution within the Gulf of Guinea; however, they appeared more available in areas where the thermocline was shallow.

The sex ratio was approximately 1 : 1 in the specimens which were large enough to be sexed. A maximum gonad index of 0.987 was recorded for female yellowfin during January. During December and January ripe males were observed, but ripe females were never seen. A maximum ova diameter of 740 micra was recorded and two groups of ova were observed to be developing at one time. Estimates of 1,300,000 to 5,431,000 ova were made on specimens 1180 mm to 1442 mm long.

The yellowfin tuna in the Gulf of Guinea was found parasitized by Pennella sp., Callotetrarhynchus sp. Caballerocotyla klawei, Hirudinella marina, and Kollikeria sp. In addition, wounds and scars of unknown origin were observed on it and other species. Caballerocotyla klawei was noted for the first time in the nasal passage of Thunnus albacares from Puerto Rico, Peru, and the Bahama Islands. Blackfin tuna, Thunnus atlanticus, also hosted the same species. Parasites of other

scombroid fishes are tabulated.

Food of the yellowfin tuna in the Gulf of Guinea consisted by volume of 76 percent fishes and 24 percent invertebrates. The major foods were anchovies, gempylids, other fishes, squid, shrimp, and larval crabs.

Observed predators on the yellowfin tuna were man and the sickle shark, Carcharhinus falciformis. The yellowfin tuna was observed to school by similar sizes. Several other species, but especially Katsuwonus pelamis, were observed swimming with them.

The age of the yellowfin tuna was estimated from length frequency modes and four classes representing ages from one to four years were found in the surface catch. Catch per day's fishing effort was used as a measure of abundance and the results are averaged by one degree of latitude for the Gulf of Guinea. (Auth. abst.)

6840. Keeton, Dee (Ph. D. Thesis, Iowa State Univ. of Sci. and Technol., Iowa City). 1963. GROWTH OF FISHES IN THE DES MOINES RIVER, IOWA, WITH PARTICULAR REFERENCE TO WATER LEVELS. Dissert. Abstracts, Vol. XXIV, No. 10, p. 3916. 1964. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-3878, 219 pp. (Microfilm $2.85; Xerography $9.90).

This study was initiated in 1959 to investigate the effects of various water levels on growth and food habits of fishes in the Des Moines River, Boone County, Iowa. In late 1959 and early 1960 a chemical bone-staining method was applied to the scales of local fishes to determine when growth was occurring. This method failed to measure fish growth accurately enough for the purposes of our study. Therefore, the seasonal growth of fish was determined by measuring large numbers of fish, usually at half-month intervals, during 1960 and 1961.

Calculated total lengths of river carpsuckers had decreased 0.1 to 2.2 inches at the first through the fifth annuli from those of a study in 1956.

As represented by Hile indexes no relationship was evident between annual growth of river carpsuckers, golden redhorses, walleyes, channel catfish, and carp and water levels or air temperatures.

Intra-seasonal growth of river carpsuckers, golden redhorses, sand, spotfin and bigmouth shiners, and bluntnose minnows was not significantly correlated with average water levels, water-level changes or temperatures. Exceptions occurred for age I river carpsuckers in 1961 when growth was significantly correlated with average water levels and water temperatures, and for age I sand and spotfin shiners in 1947 when growth was significantly correlated with air temperatures.

Between-year comparisons of seasonal growth curves indicated that the growth of river carpsuckers, spotfin and bigmouth shiners, and bluntnose minnows started later in the years when water levels were high in the early part of the growing season. Although the data in 1960 and 1961 did not indicate seasonal changes in the benthos or fish food habits with respect to water levels, high water may reduce the growth of fish by reducing the availability of food.

The spawning of sand, spotfin and bigmouth shiners was late in those years in which the water levels were high during late spring. Apparently these species do not spawn until water levels approach 1 foot on the Boone Dam gauge. (Auth. abst.)

6841. Ibert, Edward Robert (Ph. D. Thesis, Texas A & M Univ., College Station). 1963. AN INVESTIGATION OF THE DISTRIBUTION OF CARBON DIOXIDE BETWEEN THE ATMOSPHERE AND THE SEA. Dissert. Abstracts, Vol. XXIV, No. 10, pp. 4227. Avail.: University Microfilms, Inc., Ann Arbor, Michigan, Order No. 64-1531, 140 pp. (Microfilm $2.75; Xerography $6.60).

Measurements of the distribution of CO_2 between the atmosphere and the sea are presented with a description of the apparatus used and its calibration. The measurements were made on a series of cruises into the Gulf of Mexico, the northern Caribbean Sea, and the western North Atlantic Ocean; in the gas phase using a nondispersive double-beam infrared analyzer.

Four geographical patterns in the distribution of CO_2 between the phases were observed; first, pCO_2 of the air over the southwestern Gulf of Mexico, the Gulf of Campeche and a 40-mile wide strip near shore of the Louisiana Gulf coast was 303 ppm and pCO_2 of the surface waters was 270-290 ppm. The second, bounded by the Bahama Banks, the island of Bermuda and the continental United States, has a pCO_2 of 311 to 312 ppm in the air and pCO_2 of the waters was 290 ppm. A diurnal cycle in pCO_2 of the air of 4-8 ppm was observed over this area. The maximum occurred at 1800 hours local time and the minimum between 2400 and 0600. The third, consisting of the northern Caribbean and Atlantic south of the Bahama Banks, where pCO_2 of the air was 316 ppm and pCO_2 of the surface waters was between 270 and 300 ppm. A tropical rain squall in this area produced large excursions to 330 ppm of pCO_2 in the sea to a depth of 200 feet. The fourth, the eastern Gulf of Mexico from the straits of Florida to the mouth of the Mississippi River, pCO_2 in the air averaged 316 ppm and pCO_2 of the sea was above 325 ppm.

A diurnal cycle of 70 ppm in the pCO_2 of the sea was observed in the Gulf of Batabano, Cuba, the maximum was 400 ppm at the time of maximum insolation and the minimum occurred before dawn. The change in pCO_2 per degree centigrade in sea water of 19% chlorinity and pH of 8.2 was measured and is a 4.5 ppm. The change in pCO_2 with temperature is a function of pH and for the same water is 7.0 ppm per degree at pH of 8.0.

The calibration of the analyzer and the system is felt to be accurate to $\pm$ 2 ppm and the precision of a measurement in the field is within $\pm$ 2 ppm for pCO_2 of the air and $\pm$ 5 ppm for pCO_2 of the water. Water vapor was removed before analysis. In the

areas subjected to diurnal variation, the pCO_2 reported is the arithmetic average and probably represents an error in the positive sense, since no data was available to measure the thickness of the atmospheric layer affected. No vertical gradients in pCO_2 of the air were detected, although vertical gradients were present in the sea.

The distribution of CO_2 between the atmosphere and the sea varies both geographically and temporally in the areas tested. A considerable flux of CO_2 appears to be moving between phases in relatively short distances and short time intervals. (Auth. abst.)

6842. Neville, William C., and Gerald B. Talbot (Tiburon Mar. Lab., Bur. Sport Fish. & Wildl., Tiburon, California). 1964. THE FISHERY FOR SCUP WITH SPECIAL REFERENCE TO FLUCTUATIONS IN YIELD AND THEIR CAUSES. U. S. Fish and Wildlife Service, Special Scientific Report--Fisheries No. 459, 61 pp.

The catch of scup over the past 50 years has fluctuated widely. Data on this fishery for recent years (1922-35), obtained from State and Federal agencies, commercial fishery, and fishermen, have been analyzed to determine causes of fluctuations. It was found that fluctuations in the summer fishery from New Jersey to Massachusetts were caused mainly by differences in the size of the successive year classes entering the fishery. Fluctuations in the catch of the winter trawl fishery off the Virginia Capes resulted from changes in the amount of cooling of the bottom water where these fish are found in winter. During cold-water conditions, the fish became more concentrated and were more easily caught; whereas, when the water was warmer, the fish scattered more widely and were not as readily available. Although fluctuations in the catch of the summer and winter fishery have different causes, results of tagging and observations of size composition have disclosed that both fisheries draw on the same general stock. (Authors)

6843. Farrell, R. Keith (U. S. Dept. of Agric., Fur Animal Disease Lab., Washington State Univ., Pullman), Marilyn A. Lloyd, and Brian Earp. 1964. PERSISTENCE OF NEORICKETTSIAE HELMINTHOECA IN AN ENDOPARASITE OF THE PACIFIC SALMON. Science, Vol. 145, No. 3628, pp. 162-163.

Coho salmon (Oncorhynchus kisutch) infected with the metacercariae of the "salmon poisoning" fluke (Nanophyetus salmincola) remain infected after they have migrated to sea. Metacercariae remain viable in such salmon for at least 33 1/2 months. These metacercariae are capable of transmitting salmon disease (Neorickettsiae helminthoeca) to susceptible dogs throughout this period. (Authors)

6844. Barrett, Izadore (Inter-American Tropical Tuna Comm., Scripps Inst. of Oceanogr., La Jolla, California), and Frank J. Hester. 1964. BODY TEMPERATURE OF YELLOWFIN AND SKIPJACK TUNAS IN RELATION TO SEA SURFACE TEMPERATURE. Nature, Vol. 203, No. 4940, pp. 96-97.

Thermoelectric techniques were employed to measure the body temperatures of 62 live yellowfin tuna and 31 live skipjack tuna captured in the eastern tropical Pacific Ocean. The following equations were derived from the data:

yellowfin body temperature °C = 0.81 water temperature °C + 7.47

skipjack body temperature °C = 0.58 water temperature °C + 16.39

Over the size range of the fish tested, length was of minor importance in the body temperature-sea temperature relation for the yellowfin. In the skipjack, the small fish tended to have lower body temperatures than did the large. The temperature results presented offer confirmatory evidence that these two species live at a higher physiological rate than do other fishes.

6845. Dees, Lola T. (Br. of Reports, U. S. Bur. Comm. Fish., Washington, D. C.). 1964. LIST OF FISH AND WILDLIFE SERVICE PAPERS ON PHYSICAL AND CHEMICAL OCEANOGRAPHY, 1940-62. U. S. Fish and Wildlife Service, Fishery Leaflet 561, 14 pp.

This is a list of physical and chemical oceanographic papers written by scientists of the Fish and Wildlife Service and other organizations under contract to the Service.

6846. Misik, Vitazoslav (Lab. Rybarstva, Bratislava, Czechoslovakia). 1963. ESTIMATION OF THE ABUNDANCE OF THE FISH POPULATION IN THE DRAINAGE AREAS OF THE CANALS ON ZITNY OSTROV. (O DHAD ABUNDANCIE A BIOMASY RYB V ODVODNOVANYCH OBLASTECH ZITNEHO OSTROVA.) Biologia (Bratislava) 18(6): 442-449; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9623. 1964.

Fish were caught by an electric shocker in closed-in areas in the various drainage canals. Two methods of evaluation were used: (1) the DeLury method based on the regression of the number of fish in one capture on the cumulative total; (2) a method based on the relation of marked fish to the absolute number of fish. The second method appears to be more accurate. It was observed that the shocker is capable of capturing 50% of the fish population of the closed-in areas during the first fishing. (Auth. summ.)

6847. Moskalenko, B. K. 1958. BIOLOGICAL IMPROVEMENT OF SPAWNING RIVERS IN THE URAL REGION. (BIOLOGICHESKAYA MELIORATSIYA PRIURAL'SKIKH NERESTOVYKH REK.) Vopr. Ikhtiol. 10. 111-126; Referat. Zhur., Biol., 1959, No. 76078; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9628. 1964.

In order to work out scientific methods of biological improvement of the lower reaches of the Ob' tributaries, it is necessary to investigate the interspecific relationships between the fish of

spawning rivers. The above tributaries are most important for the reproduction of whitefish (Coregonus) species, as are the Ural tributaries of the Ob' River. They are the rivers Severnaya, Sos'va, Synya, Voikar, Sob', and Shchuch'ya. The local fish have a negative influence on whitefish. In places of summer foraging roach, dace, ide, perch, and ruff are food competitors. Predatory fish, mainly pike and burbot, devour reproducing whitefish in foraging places, during the migration to spawning places, in spawning places, and in hibernation areas. Predatory fish also devour the young whitefish. Burbot, grayling, minnow, and ruff feed on whitefish roe in the spawning places. There are numerous undesirable and predacious fish in the tributary rivers of the Ural. Total catches in the North Sos'va contain 23% predatory fish and 56.4% undesirable fish. The catch in the Voikar River is made up of 73% ruff and burbot. The places of whitefish fattening and those where undesirable fish are found are not separated. The undesirable and predatory fish of the North Sos'va and Synya Rivers should be caught in the tributaries of these rivers, where they hibernate. Whitefish species are not found in these tributaries. The undesirable fish are best caught in fall when they migrate to their hibernation places, and during the spring migration from the sea to the river. It is necessary to organize intensive fishing for burbot with baited hooks, and hook and line gear. (Courtesy NSF (PL 83-480) 1963)

6848. Movchan, V. A. 1962. BIOLOGICAL CHARACTERISTICS OF SELECTED CARP. (BIOLOGICHESKIE OSOBENNOSTI SELEKTSIONIRUEMOGO KARPA.) Tr. Sovesch. Ikhtiol. Komis. Akad. Nauk SSSR 14. 181-185; Referat. Zhur., Biol., 1963, No. 10I66; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9629. 1964.

Of great significance for the selection of carp is the regulation of the metabolic rate, cultivation of requisite selective characters, and management of these processes. A study was made of the differences among the gonads of carps cultivated under various conditions. A relationship between growth rate and maturation of sex glands in carp was established. When reared under less favorable conditions a retardation of development of reproductive organs occurs along with the retardation in growth rate. Selected carp are characterized by an accelerated sexual maturation and by a more intensive development of sex glands. A direct relationship was established between dimensions of the eggs and the fry produced by the eggs. The largest eggs were situated close to large blood vessels, and the smallest on the peripheries of the ovaries. For females on the artificial diet a greater number of larger eggs was observed, and in females on the natural diet there were significantly fewer large eggs.

6849. Shemanskii, Yu. A. 1963. BIONICS AND FISHING. (BIONIKA I RYBOLOVSTVO.) Priroda (USSR) 52(6): 108-109; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9650. 1964.

Four types of artificial lures which employ simple devices to generate ultrasonic vibrations are described. Field tests proved the lures highly effective. (B. Le B.)

6850. Tabata, Kenji. 1962. TOXICITY OF AMMONIA TO AQUATIC ANIMALS WITH REFERENCE TO THE EFFECT OF PH AND CARBON DIOXIDE. Bull. Tokai Reg. Fish. Res. Lab. 34. 67-74; Biological Abstracts, Vol. 45, No. 3, Abst. No. 9654. 1964.

In order to explain the effect of pH on the toxicity of ammonia, it may be necessary to consider the toxicity of a large quantity of ammonium ion, in addition to the toxicity of the un-ionized ammonia molecule and the antagonistic action of carbon dioxide which have already been recognized. Three kinds of indices to toxicity were used: (1) a value which would be inversely proportional to 24 hr. TLm as an index to the 24 hours' toxicity of ammonium solution with various pH; (2) T_m and (3) T_i which represent apparent 24 hours' toxicity due to 1 mol un-ionized ammonia or ammonium ion, respectively. T_m/T_i was confirmed to be nearly constant (51-45) within the range of pH 6.0-8,5 by the results of experiments using Daphnia pulex for test animals and low carbonate alkalinity water for dilution. By using the T_m/T_i value, therefore, toxicities of ammonium solution with various pH (6.0-8.5) could be exchanged with each other in laboratory work under controlled conditions. For practical application of derived equations to natural environmental water, however, some more factors should be taken into consideration. For instance, these equations could not be applied to the acid side of water with high carbonate alkalinity. Moreover, the T_m/T_i value differed according to different species of test animals, that is, the T_m/T_i of fishes (Lebistes or Plotosus) was greater than that of Daphnia or Artemia. (Auth.)

6851. Dornesco, G. T., and V. Santa (Anat. Lab. Univ., Bucharest, Rumania). 1963. THE STRUCTURE OF THE AORTAS AND THE BLOOD VESSELS OF THE CARP (CYPRINUS CARPIO L.). (LA STRUCTURE DES AORTES ET DES VAISSEAUX SANGUINS DE LA CARPE (CYPRINUS CARPIO L.).) Anat. Anz. 113(2): 136-145; Biological Abstracts, Vol. 45, No. 3, Abst. No. 10167. 1964.

A detailed description is presented of the structure of the ventral aorta, the dorsal aorta, and the various arteries and veins, with special reference to the following: the presence of a mediodorsal septum with a free scalloped edge along the entire dorsal aorta; the group of Plehn cells in the intima of the ventral aorta, the afferent branchial arteries, and the posterior cardinal veins; the presence of a very slack periadventitia or large lymphatic spaces surrounding the renal arteries. (Auth. summ.)

6852. Staib, A. H. (Pharmakol. Inst., Med. Akad. "Carl Gustav Carus," Dresden, E. Germany). 1962. RELATIONS BETWEEN SUPPLY AND

CONSUMPTION OF OXYGEN IN GOLDFISH (CARASSIUS AURATUS). (BEZIEHUNGEN ZWISCHEN SAUERSTOFFANGEBOT UND -VERBRAUCH BEIM GOLDFISCH (CARASSIUS AURATUS).) Acta Biol. et Med. Germ. 9(2): 145-153; Biological Abstracts, Vol. 45, No. 3, Abst. No. 10548. 1964.

The oxygen consumption of goldfish (Carassius auratus) was continuously measured under different conditions of oxygen supply in a flowing-through device by means of the electrochemical determination of the oxygen content. The activity consumption and the standard consumption of oxygen were found to be directly proportional to the oxygen supply. This dependence was most obvious in the activity metabolism. The relative metabolic values were not dependent on body weight. The time of adjustment for the standard consumption was shortened considerably by accustoming to the experimental conditions. An adjusted standard value remained constant for hours. (Auth.)

6853. Evseeva, N. G. 1958. THE EFFECT OF VISION ON THE RHEOSTATIC REFLEX IN FISH. (O ROLI ZRENIYA V REOSTATICHESKOM REFLEKSE U RYB.) Tr. Soveshch. Ikhtiol. Komis. Akad. Nauk SSSR 8. 90-92; Referat. Zhur., Biol., 1960, No. 78272; Biological Abstracts, Vol. 45, No. 3, Abst. No. 10773. 1964.

On the basis of the rheostatic reflex in fish consisting of turning their heads against the water stream and swimming with the speed of this stream thus enabling them to stay in the same place by adjusting their position in relation to rounding objects, a conditional movement reflex was produced in fish placed in still water. Sound or light was combined with movement of the water in a round tin. Application of the stimulus alone caused the fish to swim towards the source of light and halt there; the same occurred with sound stimulation. If the water movements were combined with the movement of certain objects, (vertical strips on carton cylinders placed around or on the floor of the tin), the fish swam with a speed equal to that of the water and remained still by adjusting themselves to the movements of the strips. When this object movement was used on its own, the fish swam around 3 times. This reaction was not observed in the control group. Thirty minutes after the surgical removal of the eyes of the fish (carp) the rheostatic reflex was obtained quite distinctly. When the sound stimuli (120 beats/sec) were combined with the movement of the water (to watch hand) the blind fish developed a conditional reflex of movements against the watch hands, and when the direction of the water movements changed (to sounds 45 beats/second) the direction of movements of the fish also changed. These experiments confirm the possibility of formation of temporary connections between acoustic and motor analyzers. However, these connections form when the simultaneous effects on the optic analyzer are absent, resulting in inhibition of the conditional reflex to the sound stimulus. (Courtesy NSF (PL 83-480) 1963)

6854. Orlov, I. V. 1958. ON THE PROBLEM OF IMITATIONAL REFLEXES IN FISHES. (K VOPROSU OB IMITATSIONNYKY REFLEKSAKH U RYB.) Uch. Zap. Leningradsk. Gos. Univ. 239. 101-106; Referat. Zhur., Biol., 1959, No. 64289; Biological Abstracts, Vol. 45, No. 3, Abst. No. 10807. 1964.

Defensive conditional reflexes in carps were elaborated in an aquarium divided by a longitudinal partition of plexiglass. The defense conditional reflexes and the general locomotive activity of the carps were recorded. The action of the conditioning stimulant, the light, was reinforced with electric current for the carps found in one half of the aquarium; the carps in the other half could see the light and the behavior of the carps in the first half, but did not receive any reinforcement. During the formation of the defensive conditional reflex and its differentiation, the formation of an imitational defensive reflex was observed distinguished by its resistance, and identical to the defensive conditioned reflex in its adaptive significance. (Courtesy NSF (PL 83-480) 1963)

6855. Laurent, Pierre (Coll. France, Paris, France). 1962. CONTRIBUTION TO MORPHOLOGICAL AND PHYSIOLOGICAL STUDIES OF HEART INNERVATION IN TELEOSTS. (CONTRIBUTION À L'ÉTUDE MORPHOLOGIQUE ET PHYSIOLOGIQUE DE L'INNERVATION DU COEUR DES TELEOSTÉENS.) Arch. Anat. Microscop. et Morphol. Exptl. 51(3): 337-458; Biological Abstracts, Vol. 45, No. 3, Abst. No. 11389. 1964.

Morphology was studied in the tench, carp, catfish, eel, and a number of marine fish. Cardiac innervation was supplied by afferent and efferent branches of the vagus. The former, composed of myelenated fibers of large diameter, supplies myocardiac fibers of the auricle, postvalvular endocardiac receptors of the ventricle and the epicardiac sensory plexus. The latter, composed of fine myelenated and emyelenated fibers, supplies the innervation of the sinuauricular and auriculo-ventricular passages. Electrophysiological studies, in the catfish only, showed efferent nerve impulses in volleys unrelated to cardiac activity but which could be modified by stimulation of reflexive cardiac inhibitors or by hydrodynamic means. There were four phases of afferent activity, synchronized with cardiac activity. All reflexes were inhibitory. Regulating mechanisms lacked extrinsic nerve accelerators; distension of the auricle itself produced acceleration. There was no permanent inhibitory tonus so that acceleration cannot be due to its suppression. (H. H.)

6856. Lom, J. (Protozool. Lab., Czech. Acad. Sci., Prague, Czechoslovakia). 1960. TRICHODINA RETICULATA HIRSCHMANN AND PARTSCH 1955 FROM CRUCIAN CARP, AND T. DOMERGUEI F. LATISPINA DOGEL 1940 FROM DIAPTOMUS. Vestnik Ceskoslov. Spolecnosti Zool. 24 (3): 246-257; Biological Abstracts, Vol. 45, No. 3,

Abst. No. 12982. 1964.

The Trichodina occurring on Diaptomus is ascribed to T. domerguei f. latispina, while that on the crucian carp is T. reticulata. The spp. are clearly differentiated biometrically, especially by the difference in structure of their adhesive discs. The value of these characters for taxonomic distinction is again confirmed. T. domerguei, f. latispina is not able to multiply on crucian carp; it survives only a short time on the surface of the fish and does not cause a real infection. Under laboratory conditions, it did not infect Daphnia, Cyclops, or Volvox. T. reticulata cannot be transferred permanently to Diaptomus spp. or other Entomostraca. It was found on the gills of Rana esculenta tadpoles, and was experimentally transmissible back to Carassius carassius as well as to tadpoles of Rana temporaria. There is no species specificity. The tadpoles may be infected by fish Trichodina, but they disappear again before the metamorphosis is complete. The suggestion made by Raabe that the Diaphtomus spp. are vectors is rejected. The Trichodinidae reported by some authors from lakes and pools are not independent planktonic organisms, but probably have merely been released from their hosts. (A. K. W.)

6857. Guilford, Harry G. (Univ. Wisconsin Ctr., Green Bay). 1963. NEW SPECIES OF MYXOSPORIDIA FOUND IN PERCID FISHES FROM GREEN BAY (LAKE MICHIGAN). Jour. Parasitol. 49(3): 474-478; Biological Abstracts, Vol. 45, No. 3, Abst. No. 12980. 1964.

The following histozoic Myxosporidia of perches collected from Green Bay (Lake Michigan) are described: Myxosoma neurophila sp. n. located in the neural tissue of the midbrain of Perca flavescens and Etheostoma nigrum, Myxosoma scleroperca sp. n. located within the sclerotic cartilage of Perca flavescens and Percina caprodes, and Henneguya doori sp. n. located on the gill filaments of Perca flavescens. (Auth.)

6858. Kozhina, E. S. 1958. MORPHOLOGICAL PECULIARITIES OF THE BRANCHIAL APPARATUS OF FISH IN RELATION TO THE MODE OF FEEDING. (MORFOLOGICHESKIE OSOBENNOSTI ZHABERNOGO APPARATA RYB V SVYAZI S KHARAKTEROM IKH PITANIYA.) Tr. Karel'sk. Filiala Akad. Nauk SSSR 13. 61-69; Referat. Zhur., Biol., 1959, No. 88769; Biological Abstracts, Vol. 45, No. 3, Abst. No. 13108. 1964.

The gill rakers of mature predatory fish are coarse, sparse, short, and armed with small, sharp denticles. The pike-perch has protuberances set with spines and small denticles instead of rakers, and the pike has plates armed with small denticles which help to retain large prey. The earlier the fish begin predaceous feeding, the better the small denticles on the gill arches are developed. Fish feeding on plankton and microbenthos (bleak, vendace, some whitefish) have long, thin, soft, dense rakers forming a net, which filter out small organisms. The benthophages (bream) have rod-shaped gill rakers, drawn out into cones. This corresponds to their feeding because, together with benthonic organisms, they swallow the soil in which the organisms live. Fish feeding to a considerable extent on vegetable food (roach, ide) have short, sparse rod-shaped rakers, and a thick gill arch. (Courtesy NSF (PL 83-480) 1963)

6859. Skokova, N. N. 1962. A QUANTITATIVE STUDY OF THE DIET OF FISH-EATING BIRDS. (OKOLICHESTVENROM IZUCHENII PITANIYA PTITSIKHTIOFAGOV.) In: Ornitologiya (Ornithology.) Moscow Univ.: Moscow. 4. 288-296; Referat. Zhur., Biol., 1963, No. 61222; Biological Abstracts, Vol. 45, No. 3, Abst. No. 13207. 1964.

In the Astrakhan Forest Preserve, the diet of the common cormorant (Phalacrocorax carbo), gray heron (Ardea cinerea), great white heron (Egretta alba), little egret (Egretta garzetta), night heron (Nycticorax nycticorax), spoonbill (Platalea leucorodia) and glossy ibis (Plegadis falcinellus) was studied using the procedure of the recovered weight of food (developed for study of the diet of predatory fish). Experiments in an open-air cage showed the food on the average is half-digested in fish-eating birds after 3-5 hours and is 3/4 digested after 8 hours. In the majority of birds, the number and size of the fish eaten by them could be completely reestablished after 5-6 hours from bone fragments. The food was digested more quickly in birds of lesser size. During the nesting period the birds procured food in the course of 204 hours and brought it to the nestlings 2-3 times per day. The daily norm of food in the spp. investigated varied from 120 (little egret) to 465 g (common cormorant), or 15.5-23.1% of the body weight. The fluctuations in body weight were examined (appreciable in cormorants, gray and great white herons) at different seasons depending on the food provision.

6860. Kinney, Edward C. (Div. of Fish. Mgmt. Svcs., U. S. Bur. Sport Fisheries and Wildlife, Washington, D. C.). 1964. EXTENT OF ACID MINE POLLUTION IN THE UNITED STATES AFFECTING FISH AND WILDLIFE. U. S. Fish and Wildlife Circular 191, 27 pp.

As a result of a series of Department of the Interior meetings on acid mine drainage problems, the Bureau of Sport Fisheries and Wildlife was requested to obtain data on the waters in the United States having potential for fish and wildlife which are deleteriously affected by acid mine pollution. The information concerning the waters involved was obtained from State Fish and Game Departments and pollution control agencies. It was found that 5,890 miles of streams and 14,967 acres of impoundments have a potential for fish and wildlife habitat if the acid pollution is sufficiently reduced. (Auth. Abst.)

6861. Sanford, F. Bruce, and Helen E. Plastino (Br. of Reports, U. S. Bur. Comm. Fish., Seattle, Washington). 1964. INDEX OF PUBLICATIONS BY THE BRANCH OF TECHNOLOGY,

BUREAU OF COMMERCIAL FISHERIES, 1955-59, INCLUSIVE. U. S. Fish and Wildlife Service, Fishery Leaflet 588, 28 pp.

The present leaflet continues, for the years 1955-59, the listing of publications by the Branch of Technology given in the "Index of Fishery Technological Publications of the Fish and Wildlife Service and the former Bureau of Commercial Fisheries 1918-55" by M. E. Stansby and Rosemary Schairer (Circular 96, U. S. Bureau of Commercial Fisheries), and it adheres to the same organization.

6862. Olson, P. A. 1961. EFFECT OF TREATMENT OF REACTOR EFFLUENT ON RADIONUCLIDES IN FISH. U. S. Atomic Energy Comm. Res. and Develop. Rept. HW-69500. 147-150; Biological Abstracts, Vol. 45, No. 5, Abst. No. 18298. 1964.

Treatment of reactor effluent water by passage through beds of aluminum turnings is under consideration as one means of reducing the concentration of certain radionuclides. Such treatment of the effluent was effective in reducing the P^{32} content in fish by more than 50 percent. (Auth.)

6863. von Wahlert, Gerd, and Heidi von Wahlert (Staatliches Mus. Naturk., Ludwigsburg, W. Germany). 1963. OBSERVATIONS ON SWARMING FISHES. (BEOBACHTUNGEN AN FISCHSCHWÄRMEN.) Veröffentl. Inst. Meeresforsch. Bremerhaven 8(2): 151-162; Biological Abstracts, Vol. 45, No. 5, Abst. No. 18415. 1964.

As is shown by aquarium and field observations, fishes may enter into a school with their own species or members of another species. The relation of this behavior to other milieu-factors is studied. Observations in Boops and on cichlids, support the theory that the importance of fish schools must be seen as a reinforcement system. (Auth. summ.)

6864. Funderburk, H. H., Jr., and J. M. Lawrence (Auburn Univ. Agric. Expt. Sta., Auburn, Alabama). 1963. PRELIMINARY STUDIES ON THE ABSORPTION OF C^{14}-LABELED HERBICIDES IN FISH AND AQUATIC PLANTS. Weeds 11(3): 217-219; Biological Abstracts, Vol. 45, No. 5, Abst. No. 18497. 1964.

The absorption and translocation of labeled herbicides by submersed weeds was studied by sealing the immersed root system in a 60 ml polyethylene bottle and immersing the bottle and shoots in water in a 500 ml graduate. The medium for either roots or tops could be treated without affecting the other. Simazine (2-chloro-4,6-bis(ethylamino-1-C^{14})-s-triazine) and fenac (2, 3, 6-trichlorophenylacetic acid-1-C^{14} (mixed isomers)) were absorbed by both roots and shoots of waterstargrass (Heteranthera dubia) and translocated to the untreated portion (root or shoot) of the plant. The distribution patterns of C^{14}-labeled simazine and fenac in bluegills (Lepomis macrochirus) were studied by gross autoradiography. The viscera of the fish contained the greatest amount of activity. (Authors)

6865. Kiselev, O. N., M. D. Truskanov, and M. N. Shcherbino. 1962. HYDROACOUSTIC METHOD OF DETERMINING THE QUANTITY OF FISH AT LOW POPULATION DENSITY. (GIDROAKUSTICHESKII METOD OPREDELENIYA KOLICHESTVA RYB V RAZREZHENNOM SKOPLENII.) Tr. Polyarnogo Nauchn.-Issled. i Proektivnogo Inst. Morsk. Rybn. Khoz. i Okeanogr. 13. 5-25; Referat. Zhur., Biol., 1963, No. 13I19; Biological Abstracts, Vol. 45, No. 5, Abst. No. 18520. 1964.

The magnitude of the vertical resolution of an echo sounder is determined by the duration of the emitted impulse. The positions of 2 objects can be determined by an echo sounder if the distance between them is greater than 1/2 the magnitude of the impulse in the water. The relation is $\delta_B = C\frac{t}{2}$, where δ_B is the calculated vertical resolution in meters, C is the velocity of sound in water in meters per second, and t is the duration of the impulse. For the majority of sounders T equals 1 second and δ_B = 75 meters. The actual vertical resolution is somewhat higher, since it is influenced by the shape of the impulse, the band width of amplifier transmission, degree of amplification, recording system, thickness of the pen, quality of the paper, etc. Horizontally, 2 signals from point objects will be recorded separately if the interval between their arrivals is greater than the duration of the impulse. In practice the magnitude of the horizontal resolution is 9 - 10 m at a depth of 50 m, and 13 - 15 m at a depth of 100 m. For the determination of the quantity of fish by means of an echo sounder, it is necessary to know the size of the space within the limits of which fish can be detected, i.e., the zone of action of the sounder. Diameters of zones of action of various types of sounders for various directions of the ship are given. The volume V of water in m^3 can be determined with the sounder in question by the formula

$$V = vt\left[\frac{D_1 + D_2}{2}\right]h,$$

where v is the velocity of the ship in meters, D_1 and D_2 are, respectively, the transverse distances, in meters, between the edges of the upper and lower concentration of the fish, and h is the height of the concentration in meters. The number N of fish located by the sounder during the interval t can also be computed. The density of concentration is then

$$p = \frac{N}{V} \quad \frac{\text{specimens}}{m^3}$$

The reciprocal $1/p$ is also used. In 1959, in the Barents Sea at feeding time, there were on the average 1 cod per 31.0×10^3 - $83.4 \times 10^3/m^3$ and 1 perch per $23.2 \times 10^3/m^3$. On the basis of the known densities of separate parts of the concentration, the entire volume of the concentration can be divided into sections of similar densities. The quantity of fish in the concentration can be determined by the formula

$$N = \Sigma V_p = V_1 \cdot p_1 + V_2p_2 + V_3p_3 \ldots V_np_n$$

6866. Telitchenko, M. M., and M. F. Govorova. 1962. EARLY DIAGNOSIS OF TOXICOSIS IN FISHES BY THE ERYTHROGRAM METHOD. (RANNYAYA DIAGNOSTIKA TOKSIKOZOV RYB METODOM ERITROGRAMM.) Vopr. Ikhtiol. 2(3): 393-396; Biological Abstracts, Vol. 45, No. 5, Abst. No. 18542. 1964.

A new method (based on one described by Terskov and Gitel'zon) for diagnosing early symptoms of toxicosis in fish was tested. The method consists of subjecting the fish (carp) to various toxins (blue-green algae and their metabolites, and nitrated U^{238} and Th^{232} in 5-50 mg/l) introduced into the aquarium. At regular intervals of 3, 7, 10, and 17 days a blood sample was taken from the brachial artery and treated with a hemolytic substance (HCl). The degree of hemolysis at regular intervals was then determined with the aid of a colorimeter. Percentage of hemolyzed erythrocytes plotted against time of hemolysis is called an "erythrogram." The shifting of the erythrogram peaks for the experimental group to the right or left with respect to the control group is indicative of the individual toxin assayed and its concentration. By this method the toxic effect produced by the blue-green algae was measured as insignificant. The nitrated U^{238} and Th^{232} affected amplitude and time of hemolysis in different but detectable ways. A resistance to hemolytic action was noted in erythrocytes from carp exposed to either U^{238} of Th^{232}, which increased with increased exposure. Such a resistance, believed to be vested in young erythrocytes, is conjectured as a mechanism adaptive against exposure to toxins. On the erythrograms it is seen as a shift in the curve to the right so that the peak of hemolytic action occurs at a later time. The erythrogram method is deemed reliable for detecting small changes in erythrocyte osmostability produced by toxins. (L. T. P.)

6867. Rumen, Nevenka M. (Johns Hopkins Univ., Dept. Biophys., Baltimore, Maryland), and Warner E. Love. 1963. THE SIX HEMOGLOBINS OF THE SEA LAMPREY (PETROMYZON MARINUS). Arch. Biochem. and Biophys. 103(1): 24-35; Biological Abstracts, Vol. 45, No. 5, Abst. No. 19452. 1964.

The separation and purification of the six lamprey hemoglobins from Petromyzon marinus is reported. These six hemoglobins, which are single-chain, single heme, molecules (mol. wt. = 18,400), differ in their electrophoretic mobilities and isoelectric points. They show slight differences in their absorption spectra at different pH values, minor differences in solubility in strong salt solutions and minor differences in stability at acid and alkaline pH. All these differences indicate that the primary structures of the six hemoglobins are different. Four of the six hemoglobins (1, 3, 4, 5) have been crystallized. (Authors)

6868. Hazeltine, William E. (Lake County Mosquito Abatement District, Lakeport, California). 1963. THE DEVELOPMENT OF A NEW CONCEPT FOR CONTROL OF THE CLEAR LAKE GNAT. Jour. Econ. Entomol. 56(5): 621-626; Biological Abstracts, Vol. 45, No. 5, Abst. No. 21930. 1964.

A new approach to control of the Clear Lake gnat, Chaoborus astictopus, was developed and field tested. This control was based on the use of selective doses of insecticide to kill the susceptible larval stages of the gnat, without exceeding acceptable levels in drinking water or causing any apparent damage to wildlife. Methyl parathion was used at doses of 2.3 and 3.3 ppb, applied at intervals to Clear Lake to achieve this. Procedures used and dose-mortality values obtained for various compounds on first- and fourth-instar gnat larvae and bluegill sunfish are presented, as are application methods and equipment. (Auth.)

6869. Iversen, E. S., and Bernard Yokel (Inst. Mar. Sci., Univ. Miami, Coral Gables, Florida). 1963. A MYXOSPORIDIAN (SPOROZOAN) PARASITE IN THE RED DRUM, SCIAENOPS OCELLATUS. Bull. Mar. Sci. Gulf. and Caribbean 13(3): 449-453; Biological Abstracts, Vol. 45, No. 5, Abst. No. 21949. 1964.

A description is given of a new species of myxosporidian parasite (Henneguya ocellata) located in the intestine and pyloric caeca of the red drum, caught in saline waters of South Florida. (Authors)

6870. Paperna, I. (Dept. Parasitol., Hebrew Univ. Jerusalem, Jerusalem, Israel). 1963. ENTEROGYRUS CICHLIDARUM N. GEN. N. SP., A MONOGENETIC TREMATODE PARASITIC IN THE INTESTINE OF A FISH. Bull. Res. Counc. Israel Sect. B Zool. 11B(4): 183-187; Biological Abstracts, Vol. 45, No. 5, Abst. No. 21962. 1964.

Enterogyrus cichlidarum n. gen., n. sp., an endoparasitic monogenetic trematode, from the intestine of Tilapia zilli and T. nilotica is described, found in the coastal rivers of Israel. The new genus is tentatively considered as belonging to the subfamily Tetraonchidae. (Auth.)

6871. Krykhtin, M. L. 1962. DATA ON THE RIVER STAGE OF THE SALMON ONCORHYNCHUS MASU. (MATERIALY O RECHNOM PERIODE ZHIZNI SIMY.) Izvest. Tikhookeansk. Nauchn.-Issled. Inst. Rybn. Khoz. i Okeanog. 48: 84-132; Referat. Zhur., Biol., 1963, No. 16I50; Biological Abstracts, Vol. 45, No. 5, Abst. No. 22137. 1964.

The river stage of O. masu (Brevoort) was studied from data compiled in the Amur Basin (My and Bira Rivers) and on Sakhalin (Ainskaya, Novoselovka, Bolotnaya Rivers). The spawning stock of O. masu consisted of 2 age groups, 2+ and 3+. The ratio of these 2 groups varied from year to year in the same river. During a 2-year period on Sakhalin the number of O. masu aged 2+ was, on the average, significantly higher (69%) than that of O. masu aged 3+ (31%). Dwarf males mature at 2 or 3 years. O. masu ascends the rivers earlier for spawning than other salmons, its spawning migration being limited to spring high water. In low-water years, O. masu

keep to main river channels, ascending side channels somewhat later than in high-water years. Fecundity varies from 860 to 3059 eggs (average, 1600). In Sakhalin rivers, spawning begins late in July, reaches a peak the second half of August, and ceases early in September. Spawning grounds are for the most part in upper reaches, in small abandoned river channels, and are situated significantly higher upstream than the spawning grounds of pink salmon (O. gorbuscha). Nests are constructed in shallow places with very slow-flowing water (0.07-0.20 m/sec), on clayey, sand-silt bottoms, at a water temperature of 8.6-13.4° C. Development lasts 8 months. Newly hatched fish leave their nests in April to early May. Descriptions of embryonic and larval developmental periods of O. masu are presented. Shortly after emerging from the redds, the majority of young O. masu (larvae and fry 3-3.5 cm) leave the spawning grounds, and school in upper and central parts of the river in shallow places (5-10 cm deep) with slow currents (up to 0.2 m/sec). Their food consists principally of larval chironomids and small larval mayflies and stoneflies. Scales appear at a length of 45-60 mm. The next stage (the feeding stage in main river channels) lasts until the downstream migration of young salmon. For quick-growing individuals it lasts 9-10 months (from July to April or May of the following year), for slow-growing ones 11-15 months. During this stage, the body length of young salmon increases from 45-50 to 100-150 mm. In the course of the entire period young salmon live separately in main river channels, feeding on benthos. Flying insects are eaten in summer. Eggs of Salmonidae and Leuciscus brandti are eaten at the spawning season of these fishes. Downstream migration takes place in spring, in the first half of summer and late in August at age 1+, at a length of 10-12 cm and a weight of 12-18 g. Descending migrants consume large mayfly and caddis fly larvae, as well as adult insects. Young of other Salmonidae were occasionally found in the food of 1-year-old O. masu. Bibliography includes 55 titles.

6872. Harp, George L. (Dept. of Zool., Univ. of Missouri, Columbia), and Robert S. Campbell. 1964. EFFECTS OF THE HERBICIDE SILVEX ON BENTHOS OF A FARM POND. The Journal of Wildlife Management, Vol. 28, No. 2, pp. 308-317.

The bottom fauna of plastic enclosures within a farm pond was investigated before and after treatment with the potassium salt of 2-(2,4,5-trichlorophenoxy) proprionic acid (silvex). Collections (333) by Petersen dredge were made at 28-day intervals, June 1961 through August 1962. Six polyethylene enclosures, 12 X 18 feet, were treated with silvex: 3 at 2.8 ppm concentration, 3 at 4.6 ppm. One enclosure and the open pond served as controls. The standing crop of benthos doubled numerically and gravimetrically in enclosures treated with the heavy concentration. The increase in numbers of tendipedids and oligochaetes in the treated areas was correlated with increased organic detritus afforded by decomposing rooted aquatic plants. Chaoborus increased greatly in treated enclosures. Libellulids increased 1 year after treatment. Snails, leeches, and coenagrionids appeared to be unaffected by treatment with silvex in the concentrations used. Chrysops decreased quickly in treated areas and reappeared only during the last 2 months of study, and only in enclosures treated with the lighter concentration. The composition of the benthic community of a farm pond and the control of rooted aquatic plants by silvex are described. (Authors)

6873. Cushing, C. E., Jr. (Biol. Lab., Hanford Laboratories, Richland, Washington). 1964. AN APPARATUS FOR SAMPLING DRIFTING ORGANISMS IN STREAMS. The Journal of Wildlife Management, Vol. 28, No. 3, pp. 592-594.

The design and use of a sampler for quantitatively collecting the drifting biota in streams is described. (Auth.)

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